



*Prepared for*

**United States Environmental Protection Agency**  
Region II  
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New York, New York 10007

# **YEAR 3 (2017) ANNUAL MONITORED NATURAL ATTENUATION REPORT**

## **OPERABLE UNIT 3**

**Swope Oil and Chemical Superfund Site  
Pennsauken Township, New Jersey**

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## **EXECUTIVE SUMMARY**

Geosyntec Consultants, Inc. (Geosyntec) has prepared this Year 3 (2017) Annual Monitored Natural Attenuation Report (Annual MNA Report) on behalf of the Swope Site Cleanup Committee (Committee) for the Swope Oil and Chemical Superfund Site (Site) in Pennsauken Township, New Jersey. This Annual MNA Report has been prepared to document activities completed in 2017 related to the Monitored Natural Attenuation (MNA) remedy for volatile organic compound (VOC) impacts to shallow groundwater (Operable Unit 3 [OU3]) at the Site, and to assess the progress of the OU3 remedy. The MNA remedy is being implemented in accordance with the OU3 Record of Decision (ROD). 2017 is the third year of OU3 MNA remedy implementation following the construction of a cap on the Site (Cap) to address shallow soil impacts (OU1).

The OU3 MNA remedy activities completed in 2017 include:

- Two semi-annual shallow aquifer groundwater sampling events and one annual deep aquifer groundwater sampling event;
- Collection of continuous shallow aquifer groundwater elevation data for one week preceding both semi-annual shallow aquifer groundwater sampling events using programmable pressure transducers;
- Review of the shallow aquifer transducer groundwater elevation data for both semi-annual shallow aquifer groundwater sampling events;
- Analysis of the shallow aquifer analytical data to evaluate groundwater quality trends with respect to Cap performance and off-Site source contributions; and
- Analysis of the shallow aquifer analytical data to assess whether conditions in the shallow aquifer continue to be conducive for the reductive dechlorination of chlorinated ethenes (i.e., tetrachloroethene [PCE], trichloroethene [TCE], cis-1,2-dichloroethene [cDCE], and vinyl chloride [VC]), and whether there is evidence that the natural attenuation of chlorinated ethenes is occurring.

The 2017 OU3 MNA remedy monitoring findings are as follows:

- The hydraulic gradient in the shallow aquifer at the Site is relatively flat with little variation in groundwater elevation between monitoring wells;
- Off-Site pumping stresses result in variability in the hydraulic gradient (both in direction and magnitude) near the Site, resulting in distinct shallow aquifer groundwater flow patterns;
- The shallow aquifer groundwater flow patterns observed in 2017 are consistent with the range of those observed historically, with the predominant shallow groundwater flow

direction being onto the Site from the north (near GM-02S) and southeast (near MW-10S), and the predominant groundwater flow direction off the Site being generally to the south-southwest;

- While PCE, TCE, and VC continue to be detected in the shallow aquifer near the Site at concentrations above the ROD performance standards, and cDCE continues to be detected below the ROD performance standard, as noted below, higher concentrations of CVOCs continue to be detected in off-Site, hydraulically upgradient wells;
- Shallow aquifer monitoring wells located predominantly hydraulically upgradient of the Site including MW-10S, GM-02S, and GM-05S, continue to exhibit higher PCE, TCE, and cDCE concentrations relative to shallow aquifer monitoring wells located on-Site and proximally downgradient of the Site. The observed groundwater flow patterns and current contaminant distribution indicates that upgradient off-Site sources of PCE and TCE are impacting Site groundwater;
- 1,4-Dioxane was identified as a groundwater COC in the ROD; however, Appendix II-A, Table 3 of the ROD did not identify a performance standard for this compound. Historically, 1,4-dioxane was primarily undetected in shallow groundwater in proximity to and at the Site. In more recent sampling associated with this performance monitoring program, which utilizes lower detection limits now available, 1,4-dioxane has been detected in on-Site and off-Site monitoring wells both hydraulically upgradient and downgradient to the Site.
- Shallow aquifer geochemical conditions near the Site continue to be conducive to the reductive dechlorination of chlorinated ethenes. The presence of VC in wells on-Site and proximally downgradient of the Site indicates that reductive dechlorination is actively occurring near the Site;
- The potential for on-Site VOC soil sources to impact shallow groundwater has been mitigated by the implementation of remedial actions, and off-Site upgradient sources are now the predominant sources of VOCs to shallow groundwater beneath the Site. The attenuation of on-Site shallow aquifer PCE and TCE concentrations to the ROD performance standards is being inhibited due to off-Site groundwater conditions; and,
- Deep groundwater analytical results indicate that regional VOC impacts continue to affect the on- and off-Site deep aquifer wells.

## 1. INTRODUCTION

### 1.1 Overview

This Annual MNA Report has been prepared to document activities completed in 2017 related to the MNA remedy for VOC impacts to shallow groundwater (OU3) at the Site, and to assess the progress of the OU3 remedy. 2017 is the third year of OU3 MNA remedy implementation.

This Annual MNA Report has been prepared in accordance with the following governing documents for the Site:

- *Record of Decision, Swope Oil and Chemical Company Superfund Site, Operable Unit 3 – Groundwater Remediation, USEPA (OU3 ROD) (USEPA, 2010);*
- *Final (100%) Remedial Design Report, OU3 Remedial Action, Geosyntec (OU3 100% Design) (Geosyntec, 2013a);*
- *Remedial Action Work Plan, OU1/OU3 Remedial Action, Swope Superfund Site, Geosyntec (RAWP) (Geosyntec, 2014a);*
- *Operation and Maintenance Plan, Swope Superfund Site, Geosyntec (O&M Plan) (Geosyntec, 2014b); and,*
- *Remedial Action Report, OU1/OU3, Swope Superfund Site, Geosyntec (RAR) (Geosyntec, 2015).*

### 1.2 Report Organization

The remainder of this Annual MNA Report is organized as follows:

- Section 2: Project Background Information;
- Section 3: OU3 Remedy Overview;
- Section 4: 2017 OU3 MNA Remedy Activities;
- Section 5: Hydraulic Monitoring;
- Section 6: Groundwater Monitoring Results;
- Section 7: Data Usability;
- Section 8: Conclusions;
- Section 9: Recommendations; and,
- Section 10: References.

## **2. PROJECT BACKGROUND INFORMATION**

### **2.1 Site Description**

The Site, United States Environmental Protection Agency (USEPA) ID#NJD041743220, is located at 8281 National Highway in an industrial area of Pennsauken Township, Camden County, New Jersey. The Site location is shown on **Figure 1**. The Site consists of an approximately 1.9-acre parcel of land where a chemical reclamation facility once operated. The current Site layout is shown on **Figure 2**. A chain link fence surrounds the Site. The Site is bounded to the north and east by railroad tracks and warehouses and to the southeast by National Highway. A property occupied by the Merchantville Pennsauken Water Commission (MPWC) abuts the Site to the west. The nearest residential areas to the Site are in the Townships of Delair and Morrisville, located about 0.5 miles west and 0.8 miles southeast of the Site, respectively.

### **2.2 Site History**

Historical records indicate that the Site operated as a chemical reclamation facility from 1965 through 1979, reportedly handling solvents, oils, printing inks, phosphate esters, hydraulic fluids, paints, and varnishes. The Site is one of several sites in and around Pennsauken Township that have elevated levels of VOCs in the soil and groundwater as a result of historical industrial activities.

Several phases of soil and groundwater investigation and remediation have been implemented since the initiation of Site activities in 1985; the 2015 RAR (Geosyntec, 2015) provides a brief summary of these activities.

In 2014, a multi-layer impermeable Resource Conservation and Recovery Act (RCRA) cap was constructed over the entire Site (the Cap). The Cap was installed to address remaining VOC impacts to shallow soils (OU1) by reducing infiltration across the Site, thereby limiting VOC mass transfer from residual sources in the vadose zone to shallow groundwater. OU1 Cap construction was completed in July 2014 and was certified complete by USEPA in a letter dated 5 August 2014. In August 2014, following the completion of OU1 Cap construction, dedicated groundwater monitoring equipment was installed in the fourteen (14) shallow Site monitoring wells; the 2015 RAR (Geosyntec, 2015) describes these activities. The OU3 MNA remedy groundwater monitoring program was initiated in early 2015. The first and second years of OU3 MNA remedy implementation were documented in the *Year 1 (2015) Annual Monitored Natural Attenuation Report* (2015 Annual MNA Report) (Geosyntec, 2016b) and *Year 2 (2016) Annual Monitored Natural Attenuation Report* (2016 Annual MNA Report) (Geosyntec, 2017).

## 2.3 Conceptual Site Model

### 2.3.1 Hydrostratigraphy

The Site and regional hydrostratigraphy has been the subject of detailed investigations and evaluations for decades. A thorough discussion of the hydrostratigraphy is presented in the *Supplemental Investigation Report* (Geosyntec, 2009). As described in the OU3 100% Design (Geosyntec, 2013a), the subsurface hydrostratigraphy beneath the Site can be summarized as follows:

- The Site is underlain by the Potomac-Raritan-Magothy (PRM) aquifer system which consists of the three major hydrostratigraphic units: the Upper PRM, the Middle PRM, and the Lower PRM;
- The shallow water table aquifer (shallow aquifer) occurs in the Middle PRM (Raritan formation). The deep aquifer occurs in the Lower PRM (Potomac Group sediments). The Middle and Lower PRM are separated by an aquitard, which is approximately 35 feet thick beneath the Site, but varies in thickness regionally. The Potomac Group consists primarily of medium to coarse grained sand and gravel with some thin, discontinuous clay layers. The Potomac Group is approximately 70 feet thick near the Site and the Site deep monitoring wells were installed within this stratum; and,
- Groundwater occurs under water table conditions in the Middle PRM unit at approximately 70 to 80 feet below ground surface (bgs) and under semi-confined to confined conditions within the Lower PRM unit at approximately 170 feet bgs.

### 2.3.2 Groundwater Flow Conditions

As described in the OU3 ROD (USEPA, 2010) and USEPA's most recent (2017) *Five-Year Review Report* for the Site (USEPA, 2017), the natural groundwater flow direction near the Site is northward towards the Delaware River. However, pumping induced gradients associated with groundwater withdrawals for water supply in Camden County have altered the groundwater flow patterns in both the shallow and deep aquifers near the Site. In general, groundwater flow in the deep aquifer has been consistently to the south under the influence of pumping wells near to Camden. Groundwater flow conditions in the shallow aquifer have been found to be variable as they are strongly affected by changes in the pumping rates of nearby well fields.

Transducer studies conducted in 2008/2009 and in 2012 resolved historically conflicting groundwater flow interpretations that had been developed during the prior 25-year remedial investigation period and clarified the variable groundwater flow conditions in the shallow aquifer. Figures from the OU3 100% Design that illustrate the findings of the 2008/2009 and 2012 transducer studies are included in **Appendix A**.

The 2008/2009 and 2012 shallow aquifer transducer studies found that the hydraulic gradient in the shallow aquifer at the Site is relatively flat and groundwater flows slowly under the Site. The studies also found that groundwater in the shallow aquifer flowed onto the Site from both the north and the south, converged and flowed off the Site towards the west.

Transducer data collected during the 2017 monitoring showed groundwater in the shallow aquifer flowing onto the Site from the north and from the south/southeast. Convergent groundwater flow was observed during the spring semi-annual monitoring event in 2017.

### **2.3.3 Historical Groundwater VOC Conditions**

The OU3 100% Design (Geosyntec, 2013a) includes a detailed discussion of the historical Site groundwater VOC conditions (i.e., prior to the construction of the OU1 Cap). Tables and figures from the OU3 100% Design relevant to the historical Site groundwater VOC conditions are included in **Appendix A**.

#### **2.3.3.1 Shallow Aquifer**

##### **PCE, TCE and cDCE**

VOCs, specifically PCE, TCE, and cDCE, have historically been detected at low levels in the shallow aquifer beneath the Site. These compounds have also been historically detected in wells located hydraulically upgradient from the Site. These regional VOC impacts have been well documented over decades of remedial investigations and in the OU3 ROD (USEPA, 2010), USEPA acknowledged that upgradient off-Site sources of these compounds contribute to the shallow groundwater impacts at the Site. The potential for on-Site soil VOC sources to impact shallow groundwater has been mitigated by the implementation of remedial actions, including the OU1 Cap, as described in the 2015 RAR (Geosyntec, 2015). It is anticipated that the low-level VOC concentrations in the shallow aquifer potentially associated with the Site will naturally attenuate.

##### **1,4 – Dioxane**

1,4-Dioxane was identified as a groundwater COC in the ROD, however Appendix II-A, Table 3 of the ROD did not identify a performance standard for this compound. In most instances, 1,4-dioxane was primarily undetected in shallow groundwater in proximity to and at the Site. In more recent sampling associated with this performance monitoring program, which utilizes lower detection limits now available, 1,4-dioxane has been detected in on-Site and off-Site monitoring wells both hydraulically upgradient and downgradient of the Site.

### *2.3.3.2 Deep Aquifer*

Deep aquifer groundwater monitoring wells upgradient of the Site have historically exhibited VOC concentrations greater than concentrations on or downgradient from the Site. As a result of these documented historical conditions, USEPA acknowledged that contaminants in the on-Site deep wells are likely the result of upgradient sources. Therefore, the OU3 ROD (USEPA, 2010) requires one annual groundwater monitoring event in the deep aquifer.

### **3. OU3 REMEDY OVERVIEW**

#### **3.1 Summary of the OU3 Remedy**

The OU3 remedy was selected by USEPA with the concurrence of the New Jersey Department of Environmental Protection (NJDEP). The OU3 remedy presented in the OU3 ROD (USEPA, 2010) includes the following primary components:

1. MNA for the shallow aquifer;
2. Groundwater monitoring for the deep aquifer; and,
3. Establishment of a Classification Exception Area (CEA), which is an institutional control, to minimize the potential for exposure to contaminated groundwater until the aquifer meets the cleanup goals. The CEA footprint includes the entire Site property boundary as well as a portion of the MPWC property to the west of the Site, as provided on **Figure 2a**.

The OU3 MNA remedy for shallow groundwater was initiated following the final inspection of the completed OU1 Cap. In August 2014, as described in the 2015 RAR, dedicated groundwater monitoring equipment was installed in the fourteen (14) shallow aquifer monitoring wells. The first OU3 MNA remedy shallow aquifer sampling event was completed in the first quarter (Q1) of 2015. Quarterly shallow aquifer sampling events were completed in 2015 and 2016, for a total of eight (8) rounds of groundwater sampling. Per the approved OU3 100% Design (Geosyntec, 2013a) and RAWP (Geosyntec, 2014a), 2017 was the first year of semi-annual shallow aquifer sampling events.

The first annual deep aquifer sampling event was completed in October 2015 using Snap Sampler® passive groundwater sampling devices. In October 2016 and November 2017, the second and third annual deep aquifer sampling events were completed using passive diffusion bag samplers (PDBs). Future annual deep aquifer sampling events will also be completed using PDBs. Per the OU3 100% Design (Geosyntec, 2013a) and RAWP (Geosyntec, 2014a), the deep aquifer will continue to be monitored on an annual basis.

The application for the Site CEA was submitted as Appendix D of the RAWP (Geosyntec, 2014a), and the CEA was established by NJDEP effective 4 February 2014. Biennial recertification of the CEA was completed in February 2016 and February 2018.

#### **3.2 Performance Standards for the OU3 MNA Remedy**

As set forth in Appendix II-A, Table 3 of the OU3 ROD (USEPA, 2010), the applicable cleanup standards for the OU3 MNA remedy were identified as the lower of the State of New Jersey

Class II-A Ground Water Quality Standards (NJGWQSs [II-A]) or the Federal Maximum Concentration Limits (MCLs). These standards are referred to herein as the “ROD performance standards”.

Per the OU3 100% Design (Geosyntec, 2013a), PCE, TCE, cDCE, and VC are the primary Site COCs subject to the MNA performance evaluation.

USEPA acknowledged in the OU3 ROD (USEPA, 2010) that off-Site groundwater VOC sources exist in the immediate vicinity of the Site at levels above NJGWQSs. Section XII of the Statement of Work (i.e., Appendix A of the *Administrative Settlement Agreement and Order on Consent for the Development of the Remedial Design, Operable Unit 1* (USEPA, 2011a)) describes a process by which the Committee may propose to modify the performance standards.

### 3.3 Applicable or Relevant and Appropriate Regulations for OU3

Applicable State regulations include the NJDEP *Technical Requirements for Site Remediation* (TRSR) promulgated as N.J.A.C. 7:26E (NJDEP, 2012a). These regulations provide requirements for conducting remedial investigations and remedial actions at a site. The applicable State cleanup standards for groundwater at the Site are the NJGWQSs promulgated as N.J.A.C. 7:9C. These standards provide the basis for protection of ambient groundwater quality in New Jersey through the establishment of constituent standards for groundwater pollutants. They are equivalent to or more stringent than the Federal MCLs. MCLs are promulgated in the Safe Drinking Water Act (SDWA) under 40 CFR 141-149. Sampling protocols for collection of groundwater and other environmental media are outlined in NJDEP’s *Field Sampling Procedures Manual* (FSPM) (NJDEP, 2011).

## 4. 2017 OU3 MNA REMEDY ACTIVITIES

### 4.1 Chronology and Description of Events

The table below summarizes the OU3 MNA remedy activities that were completed in 2017:

Date	Description
April 20, 2017	Pre-SA1 shallow well sampling event: transducer deployment
May 1, 2017	SA1 shallow well sampling event <sup>1</sup>
October 23, 2017	Pre-annual deep well sampling event: PDB deployment
October 30, 2017	Pre-SA2 shallow well sampling event: transducer deployment
November 6, 2017	SA2 shallow well sampling event <sup>2</sup> ; annual deep well sampling event

Abbreviations:

SA: Semi-annual

SA1: First semi-annual event

SA2: Second semi-annual event

### 4.2 Semi-Annual Shallow Aquifer MNA Groundwater Sampling Events

Semi-annual (SA) shallow aquifer MNA groundwater sampling events were completed in 2017 in May (SA1) and November (SA2). The semi-annual sampling events were conducted in accordance with the OU3 100% Design (Geosyntec, 2013a), the RAWP (Geosyntec, 2014a), the 2016 Annual MNA Report, the associated Field Sampling Plan (FSP) (Geosyntec, 2013b), and the Remedial Action Quality Assurance Project Plan (QAPP) (Geosyntec, 2016a), as follows:

- Approximately one week prior to each sampling event, programmable pressure transducers (and a barometric pressure logger) were deployed in the shallow wells;
- A synoptic round of manual groundwater level gauging measurements was completed at the start of each shallow aquifer sampling event;
- During each shallow aquifer sampling event, the fourteen (14) shallow wells comprising the Site-associated shallow aquifer monitoring well network were purged and sampled using the dedicated bladder pumps installed in each well and following NJDEP low-flow sampling protocols;

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<sup>1</sup> During the SA1 event, shallow wells MW-01, MW-04, MW-07, and MW-10S were split-sampled between Geosyntec and USEPA.

<sup>2</sup> USEPA did not collect split samples during the SA2 event.

- During the purging of each shallow well, periodic measurements were made of the depth to groundwater as well as the following groundwater quality parameters: pH, temperature, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity. Samples were collected from the shallow wells only after the groundwater quality parameters had stabilized to within ranges specified in the FSP; and,
- During each quarterly shallow aquifer sampling event, the fourteen (14) Site-associated shallow wells were sampled for laboratory analysis of VOCs, 1,4-dioxane, iron and manganese (total and dissolved), total suspended solids (TSS), total alkalinity, dissolved hydrocarbon gases (methane, ethane, and ethene), total organic carbon (TOC), sulfate, and nitrate, by analytical methods specified in the QAPP.

The stabilized groundwater quality parameter measurements for each shallow well for each quarterly sampling event are summarized in **Table 1**. The monitoring well low-flow purging and sampling records from each quarterly sampling event are included in **Appendix B**. The 2017 laboratory analytical reports and data validation documentation are included in **Appendix C**.

#### 4.3 Deep Aquifer Monitoring Activities

The first annual deep aquifer sampling event was completed in October 2015 using Snap Samplers®. However, the presence of fine sediment in deep well GM-01D and mechanical failures in other deep wells caused issues with the collection of some of the 2015 annual deep aquifer samples using the Snap Samplers®. These issues prompted the change in the deep well sampling method from Snap Samplers® to PDBs, as discussed in the 2016 Annual MNA Report.

##### 4.3.1 Deep Aquifer Monitoring: PDB Deployment

On October 23, 2017, Geosyntec deployed one (1) 500 mL PDB in each of the eight (8) Site-associated deep wells. The PDBs were purchased from EON Products, Inc. (EON) of Snellville, Georgia and were supplied with pre-filled ASTM I deionized water. In accordance with the FSPM, prior to the deployment of a PDB in a deep well a manual groundwater level gauging measurement was collected. The PDBs were deployed in each of the deep wells in the middle of the screened interval using a one-time-use (i.e., disposable) polypropylene rope tether with a stainless-steel weight at the end. The stainless-steel weights were cleaned with a non-phosphate detergent and distilled water prior to deployment in the deep wells. On the day of PDB deployment, in accordance with the FSPM, a modified field blank sample (MFB) was collected for laboratory analysis of VOCs. The MFB was collected from a “blank” PDB that had been shipped along with the PDBs from EON. The blank PDB contained the same water that was used to pre-fill the PDBs that were deployed in the deep wells. The PDB deployment tasks were conducted in accordance with a Standard Operating Procedure (SOP) prepared by Geosyntec. The SOP, which was prepared in accordance with the FSPM, was included with the revised

QAPP that was submitted to USEPA in September 2016 (Geosyntec, 2016a). The PDBs were left to equilibrate in the deep wells for two weeks prior to retrieval and sample collection.

#### **4.3.2 Deep Aquifer Monitoring: Annual Sampling Event**

The 2017 annual deep aquifer monitoring sampling event was completed on November 6, 2017. In accordance with the FSPM, a manual groundwater level gauging measurement was collected prior to the retrieval of a PDB from a deep well. Deep aquifer monitoring samples were collected from the PDBs following the procedures outlined in the SOP. The deep well samples were submitted for laboratory analysis of VOCs in accordance with the FSP and QAPP. The one-time-use polyethylene rope tethers were discarded after retrieval from the wells while the stainless-steel weights were decontaminated and retained for future use. The 2017 laboratory analytical report and data validation documentation are included in **Appendix C**.

## 5. HYDRAULIC MONITORING

### 5.1 Groundwater Elevation Data Collection

#### 5.1.1 Shallow Aquifer

Per the OU3 100% Design (Geosyntec, 2013a) and the 2016 Annual MNA Report, programmable pressure transducers were used to collect instantaneous groundwater elevation measurements continuously at each of the fourteen (14) Site-associated shallow wells for one week preceding each shallow aquifer sampling event. The instantaneous groundwater elevation measurements were collected using Solinst Model 3001 Levellogger® pressure transducers. A Solinst Model 3001 Barologger® barometric pressure logger (barologger) was deployed at the Site concurrently with the deployment of the pressure transducers in the shallow wells. Transducer and barologger measurements were collected at a frequency of one measurement every 15 minutes. The barologger data were used to adjust the pressure transducer data for atmospheric pressure, allowing the transducer measurements, initially in units of pressure, to be converted to units of feet of hydraulic head above the sensor. The adjusted measurements were converted to groundwater elevation measurements using manual groundwater level gauging measurements collected at the time of transducer deployment. A synoptic round of manual groundwater level gauging measurements was collected at the beginning of both shallow well sampling events, prior to the commencement of purging and sampling activities. The 2017 shallow well groundwater level gauging measurements are summarized in **Table 2**.

#### 5.1.2 Deep Aquifer

Manual groundwater level gauging measurements were collected at each of the eight (8) Site-associated deep aquifer monitoring wells prior to deployment and retrieval of the PDBs used to collect the annual deep aquifer monitoring samples in November 2017. The 2017 deep well groundwater level gauging measurements are summarized in **Table 3**.

### 5.2 2017 Shallow Aquifer Groundwater Flow Conditions

The hydraulic position groupings of the fourteen (14) Site-associated shallow aquifer monitoring wells are based on their typical hydraulic position relative to the Site, as discussed in the 2016 Annual MNA Report:

- On-Site wells: GM-01S, GM-03RS, MW-01, MW-02, and MW-04;
- Off-Site upgradient wells: GM-02S, GM-05S and MW-10S; and,
- Off-Site downgradient/sidegradient wells: GM-06S, GM-07S, GM-08S, MW-07, MW-09S, and MW-11S.

The off-Site upgradient wells are those that have been observed to typically be upgradient from the Site, while the off-Site sidegradient/downgradient wells are those that have been observed to typically be downgradient or sidegradient from the Site.

Generally consistent with the findings of the 2008/2009 and 2012 transducer studies and the 2015 and 2016 transducer data, the 2017 transducer data indicate the following (**Figures 3a and 3b and Figures 4a and 4b**):

- The hydraulic gradient in the shallow aquifer at the Site is relatively flat with little variation in groundwater elevation between wells;
- Off-Site pumping stresses result in variability in the hydraulic gradient (both in direction and magnitude) near the Site resulting in distinct groundwater flow patterns;
- The predominant direction of groundwater flow onto the Site is from the north (i.e., from the direction of GM-02S) with a component from the southeast (i.e., from the direction of MW-10S); and,
- The predominant groundwater flow direction off the Site is generally to the south-southwest.

## 6. GROUNDWATER MONITORING RESULTS

### 6.1 Shallow Aquifer Groundwater Quality Parameters

In 2017, measurements of groundwater quality parameters including pH, temperature, specific conductance, dissolved oxygen (DO), oxidative-reduction potential (ORP), and turbidity were collected at each shallow well during each quarterly shallow well sampling event. The stabilized groundwater quality parameter values for each shallow well for each sampling event are presented in **Table 1**. The 2017 shallow aquifer groundwater quality parameter measurements were generally consistent with the 2015 and 2016 measurements.

### 6.2 Shallow Aquifer Geochemical Conditions

In 2017, the geochemical conditions present at each shallow well were evaluated at the time of each semi-annual shallow well sampling event via the collection and analysis of groundwater samples for total and dissolved iron and manganese, TSS, alkalinity, dissolved hydrocarbon gases (methane, ethane, and ethene), TOC, sulfate, and nitrate. The geochemical parameter analytical results are presented in **Table 4** and on **Figure 5**.

The 2017 shallow aquifer geochemical analytical parameter results indicate the following:

- Iron and manganese primarily exist in the soluble (i.e., reduced) state, indicating the existence of reducing geochemical conditions.
- The presence of methane on-Site and at downgradient/sidegradient locations is an indicator of strongly reducing conditions as methanogenesis generally occurs only after the electron acceptors oxygen, nitrate, and sulfate have been depleted in groundwater.
- Ethane and ethene are the end products of reductive dechlorination of chlorinated ethanes/ethenes and have historically been and continue to be detected on-Site and at downgradient/sidegradient locations (**Appendix A** and **Table 4**). The highest concentrations of ethane and ethene continue to be detected on-Site and at downgradient/sidegradient locations.
- The predominance of dissolved iron and manganese in Site groundwater, and the presence of methane, ethane, and ethene on-Site and at downgradient locations are indicative of strongly reducing geochemical conditions that are conducive to the reductive dechlorination of PCE and TCE in the shallow aquifer.

### 6.3 Distribution of VOCs in Groundwater

Shallow and deep aquifer 2017 groundwater sample analytical results are summarized on **Table 4** and **Table 5**, and the analytical results for PCE, TCE, cDCE, and VC are presented on

**Figure 5** and **Figure 6**. Isoconcentration maps illustrating the spatial distributions of TCE and cDCE in the shallow aquifer for each 2017 quarterly sampling event are presented on **Figures 7a** through **10b**.<sup>3</sup> Note that isoconcentration contours were not drawn for PCE or VC because only low-level concentrations at or slightly above the ROD performance standards were detected.

### ***6.3.1 Shallow Aquifer***

#### ***6.3.1.1 PCE***

In 2017, PCE was detected slightly above the ROD performance standard of 1 µg/L at 13 of the 14 shallow aquifer wells. At these 13 wells, PCE concentrations ranged from 1.1 to 4.3 µg/L. PCE was not detected above the ROD performance standard at downgradient/sidegradient well MW-07. In 2017, similar to previous years, the highest PCE concentrations were consistently detected off-Site and upgradient (this year at monitoring well GM-02S).

#### ***6.3.1.2 TCE***

In 2017, TCE was detected above the ROD performance standard of 1 µg/L at all 14 of the shallow aquifer wells with concentrations ranging from 1.5 to 143 µg/L. In 2017, and generally consistent with 2015 and 2016, the highest TCE concentrations were detected at off-Site upgradient well MW-10S.

#### ***6.3.1.3 cDCE***

In 2017, consistent with 2015 and 2016, cDCE concentrations in the shallow aquifer were below the ROD performance standard of 70 µg/L at all locations. In 2017, similar to previous years, the highest cDCE concentration was detected at off-Site upgradient well MW-10S. cDCE is an intermediate compound in the reductive dechlorination of PCE and TCE, and the presence of cDCE in shallow groundwater indicates that reductive dechlorination of the parent compounds is occurring near the Site.

#### ***6.3.1.4 VC***

In 2017, consistent with the results in 2015 and 2016, VC concentrations in the shallow aquifer were below the ROD performance standard of 1 µg/L at all on-Site locations. In 2017, VC was

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<sup>3</sup> As noted in the OU3 100% Design (Geosyntec, 2013a), MW-01 is screened at a depth consistent with other shallow monitoring wells on-Site, whereas MW-02 is screened at a shallower interval. MW-02 had been slated for abandonment in favor of retaining MW-01, but variability between COC data for MW-01 and MW-02 deferred those plans. The higher concentration of each COC for MW-01 and MW-02 was used for isoconcentration contour figures in the OU3 100% Design; **Figures 7a** through **10b** follow this protocol.

detected at off-Site downgradient/sidegradient well GM-08S at concentrations above the ROD performance standard. VC is the last intermediate compound before complete reductive dechlorination of PCE and TCE to ethene, and the presence of VC in shallow groundwater indicates that the reductive dechlorination of the parent compounds is occurring near the Site.

#### *6.3.1.5 1,4-Dioxane*

In addition to the COCs listed above, 1,4-dioxane samples have been collected from shallow monitoring wells during this performance monitoring program and analyzed via USEPA Method 8270D SIM. The highest detections of 1,4-dioxane in the 2015 to 2017 data were at MW-02 and MW-9S. MW-02 is on the western edge of the former Swope property and MW-9S is off-Site to the west. 1,4-Dioxane has also been detected in wells hydraulically upgradient from the Site over the monitoring period. The more recent sampling events for MW-02 and MW-9S show decreasing 1,4-dioxane concentrations as illustrated on Figures 15a through 15d. Comparison of the 2015-2017 results with previously collected samples was not possible due to the historic high laboratory detection limits for 1,4-dioxane. Geosyntec will continue to evaluate concentration trends in 2018.

### 6.3.2 Deep Aquifer

The concentrations of VOCs detected in the deep aquifer in 2017 are consistent with those detected in 2015 and 2016 (**Table 5**). The November 2017 deep aquifer sampling results are summarized as follows (**Figure 6**):

- PCE was detected slightly above the ROD performance standard of 1 µg/L in five of the eight deep aquifer wells. At these wells, detected PCE concentrations ranged from 1.1 to 2.5 µg/L, with the highest concentration detected at off-Site upgradient well GM-06D;
- TCE was detected above the ROD performance standard of 1 µg/L in seven of the eight deep aquifer wells. At these wells, the detected TCE concentrations ranged from 3.2 to 25.4 µg/L, with the highest concentration detected at off-Site well GM-08D;
- cDCE was detected below the ROD performance standard of 70 µg/L at all eight deep aquifer wells; and,
- VC was detected above the ROD performance standard of 1 µg/L in two of the eight deep aquifer wells. At these wells, detected VC concentrations ranged from 1.2 to 1.5 µg/L, with the highest concentration detected at off-Site well GM-08D.

The deep aquifer exists within the Lower PRM, which is separated from the shallow aquifer by an aquitard approximately 35 feet thick beneath the Site. The existence of PCE, TCE, and cDCE in the deep aquifer indicates a regional presence of VOC impacts.

## 6.4 Shallow Aquifer VOC Trend Analysis

In accordance with the OU3 100% Design (Geosyntec, 2013a), to evaluate OU3 MNA remedy progress, Geosyntec analyzed the post-Cap trends in shallow monitoring well VOC concentrations using the Mann-Kendall trend test and by calculation of first-order natural attenuation rates. These analyses are presented in **Table 6** and **Table 7** and **Appendices D** and **E**, respectively. For the on-Site wells, the analyses indicate no significant overall trend in PCE concentrations, a slightly increasing trend in TCE concentrations, and an overall increasing trend in cDCE concentration. A trend could not be calculated for VC since there were too few detections. Overall, VOC concentrations in groundwater beneath the Site are low with respect to historical conditions. The spatial concentration patterns and upgradient trends, as illustrated by time series plots for PCE, TCE, cDCE, and VC groundwater concentrations (**Figures 11a** through **14d**), clearly illustrate that upgradient off-Site sources of VOCs (chloroethenes) are impacting groundwater quality on-Site.

The time series plots shown on **Figures 11a** through **14d** present the concentrations of PCE, TCE, cDCE, and VC detected at upgradient, on-Site, and downgradient/sidegradient monitoring wells since 2012 (i.e., beginning prior to the construction of the OU1 Cap in 2014). The “a” figures present the highest concentrations of each VOC detected in an upgradient, on-Site, or downgradient/sidegradient shallow aquifer monitoring well by sampling event, while the “b”, “c”, and “d” figures present the concentrations of each VOC detected in individual upgradient, on-Site, or downgradient/sidegradient shallow aquifer monitoring wells, respectively, by sampling event.

#### 6.4.1 PCE

The key findings of the analysis of the PCE time series plots are as follows:

- **Figure 11a** illustrates that:
  - The highest on-Site concentrations of PCE have decreased significantly since 2012, while the highest upgradient concentrations are increasing;
  - In 2017 the highest upgradient concentrations of PCE were consistently greater than the highest on-Site or downgradient/sidegradient concentrations;
- **Figures 11b** and **11c** illustrate that in 2017 upgradient concentrations, on average, were increasing, while on-Site PCE concentrations were stable; and,
- **Figure 11d** illustrates that in 2017 downgradient/sidegradient PCE concentrations were generally stable.

These results are consistent with the existence of sources of PCE upgradient of the Site that are continuing to impact groundwater beneath the Site. On-Site PCE concentrations have been relatively stable since 2015 and are due to transport from upgradient sources.

#### 6.4.2 TCE

The key findings of the analysis of the TCE time series plots are as follows:

- **Figure 12a** illustrates that, except for one sampling event in 2016, the highest upgradient concentrations of TCE have been consistently and significantly greater than the highest on-Site or downgradient/sidegradient concentrations, and that downgradient/sidegradient concentrations are increasing while on-Site concentrations are stable;
- **Figure 12b** illustrates that TCE concentrations at upgradient well MW-10S southeast of the Site are consistently and significantly greater than the concentrations at upgradient wells GM-02S and GM-05S north and northeast of the Site;

- **Figure 12c** illustrates that the highest on-Site concentrations of TCE have consistently been detected at wells MW-04 and GM-03RS, which are the on-Site wells most proximally downgradient of MW-10S, and that on-Site TCE concentrations have remained relatively stable since prior to the construction of the Cap; and,
- **Figure 12d** illustrates that downgradient/sidegradient TCE concentrations have slightly increased since 2015, particularly in GM-07S and GM-08S.

These results are consistent with the existence of a source of TCE upgradient and generally to the southeast of the Site (i.e., as evidenced by groundwater quality at well MW-10S) that is continuing to impact groundwater beneath the Site.

#### 6.4.3 cDCE

The key findings of the analysis of the cDCE time series plots are as follows:

- **Figure 13a** illustrates that, except for one sampling event in 2016, the highest upgradient concentrations of cDCE have been consistently greater than the highest on-Site or downgradient/sidegradient concentrations, and that concentrations of cDCE in shallow groundwater have remained below the ROD performance standard of 70 µg/L;
- **Figure 13b** illustrates that, except for one sampling event in 2016, cDCE concentrations at upgradient well MW-10S southeast of the Site are consistently and significantly greater than the concentrations at upgradient wells GM-02S and GM-05S north and northeast of the Site, and that the concentration of GM-02S upgradient of the Site has been generally increasing;
- **Figure 13c** illustrates that the highest on-Site concentrations of cDCE have consistently been detected at well GM-03RS, which is the on-Site well most proximally downgradient of MW-10S, and that in 2017 cDCE concentrations have increased at GM-03RS and MW-04; and,
- **Figure 13d** illustrates that since 2015 downgradient/sidegradient cDCE concentrations have remained relatively stable.

Although cDCE concentrations have decreased overall since 2012, the concentration increases in 2017 at GM-03RS and MW-04 and its presence is an indicator that the reductive dechlorination of PCE and TCE is ongoing near or on the Site.

#### 6.4.4 VC

The VC time series plots (Figures 14a, b, c, and d) indicate that VC detections are low, are in some cases sporadic, and have been limited to only seven (7) of the fourteen (14) Site shallow aquifer monitoring wells (i.e., upgradient wells GM-02S and GM-05S, on-Site wells GM-03RS

and MW-02, and downgradient/sidegradient wells GM-06S, GM-08S, and MW-09S) since 2012. In addition, the highest concentrations of VC have most often been detected at downgradient/sidegradient well MW-09S. An exception is the 2017 concentrations of VC detected at GM-08S, which exceeded prior concentrations at MW-09S since 2012. The consistent detection of VC at upgradient well GM-02S and downgradient/sidegradient well MW-09S, and recent (2016 and 2017) detections at downgradient/sidegradient well GM-08S, indicates that the reductive dechlorination of cDCE is consistently occurring near these locations.

## 7. DATA USABILITY

Groundwater, field blank, trip blank, and field duplicate samples were reported in Contract Laboratory Program (CLP) Data Packages received from SGS Accutest Laboratories in Dayton, New Jersey and Pace Analytical Energy Services, LLC, in Pittsburgh, Pennsylvania. All samples were analyzed per the revised 2016 QAPP (Geosyntec, 2016a).

A Stage 2A validation was performed on 100% of the data. None of the data were rejected; however, qualifications were applied to some of the data based on the results of the associated quality control samples. The samples were assessed against the results from the associated method blanks, laboratory control samples, matrix spike/matrix spike duplicate samples, laboratory duplicates, surrogate recoveries, serial dilutions, and post digestion spikes as applicable to the analysis. Analyte qualifications are listed in **Appendix C** by sample delivery group (SDG) and analytical test.

## 8. CONCLUSIONS

The 2017 OU3 MNA remedy monitoring findings are as follows:

- The hydraulic gradient in the shallow aquifer at the Site is relatively flat with little variation in groundwater elevation between wells;
- Off-Site pumping stresses result in variability in the hydraulic gradient (both in direction and magnitude) near the Site resulting in distinct shallow aquifer groundwater flow patterns;
- The shallow aquifer groundwater flow patterns observed in 2017 are consistent with the range of those patterns observed historically, with the predominant shallow groundwater flow direction being onto the Site from the north (near GM-02S) and southeast (near MW-10S), and the predominant groundwater flow direction off the Site being generally to the south-southwest;
- While PCE, TCE, and VC continue to be detected in the shallow aquifer near the Site at concentrations above the ROD performance standards, and cDCE continues to be detected below the ROD performance standard, as noted below, higher concentrations of CVOCs continue to be detected in off-Site, hydraulically upgradient wells;
- Shallow aquifer monitoring wells located hydraulically upgradient of the Site, including MW-10S, GM-02S, and GM-05S, continue to exhibit higher PCE, TCE, and cDCE concentrations relative to shallow aquifer monitoring wells located on-Site and proximally downgradient of the Site. The observed groundwater flow patterns and current contaminant distribution indicates that upgradient off-Site sources of PCE, TCE, and cDCE are impacting Site groundwater;
- Shallow aquifer geochemical conditions near the Site continue to be conducive to the reductive dechlorination of chlorinated ethenes. The presence of VC in wells on-Site and proximally downgradient of the Site indicates that reductive dechlorination is actively occurring near or on the Site;
- 1,4-Dioxane was identified as a groundwater COC in the ROD; however, Appendix II-A, Table 3 of the ROD did not identify a performance standard for this compound. Historically, 1,4-dioxane was primarily undetected in shallow groundwater in proximity to and at the Site. In more recent sampling associated with this performance monitoring program, which utilizes lower detection limits now available, 1,4-dioxane has been detected in on-Site and off-Site monitoring wells both hydraulically upgradient and downgradient to the Site;
- The potential for on-Site soil VOC sources to impact shallow groundwater has been mitigated by the implementation of remedial actions, and off-Site upgradient sources are

now the predominant sources of VOCs to shallow groundwater beneath the Site. The attenuation of on-Site shallow aquifer PCE and TCE concentrations is being inhibited due to these off-Site groundwater conditions. As a result, the attenuation of on-Site shallow aquifer PCE and TCE concentrations to the ROD performance standards is unlikely to be achieved by Year 5 of the MNA program. Deep groundwater analytical results indicate that regional VOC impacts continue to affect the on- and off-Site deep aquifer wells.

## **9. RECOMMENDATIONS**

### **9.1 Shallow Aquifer MNA Sampling Program**

As presented in the OU3 100% Design (Geosyntec, 2013a), the MNA sampling program consists of semi-annual sampling of the 14 shallow monitoring wells during years four and five of the MNA remedy, and annual sampling thereafter, if necessary, to assess shallow groundwater contaminant attenuation.

2017 was the first year of semi-annual shallow aquifer sampling events. In 2017, shallow aquifer sampling events were conducted in May and November. 2018 will be the second year of semi-annual shallow aquifer sampling events. Geosyntec recommends no changes to the MNA groundwater sampling program at this time.

As discussed above, the attenuation of on-Site shallow aquifer PCE and TCE concentrations to the ROD performance standards is unlikely to be achieved by Year 5 of the MNA program given the persistence of upgradient off-Site sources.

### **9.2 Deep Aquifer Monitoring Program**

Groundwater samples from deep aquifer monitoring wells will continue to be collected on an annual basis. Deep aquifer sampling events are anticipated to be conducted in the fall of each year. As conducted in 2016 and 2017, the deep aquifer will be monitored using PDBs. Geosyntec recommends no changes to the deep aquifer groundwater sampling program at this time.

## **10. REFERENCES**

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## **TABLES**

**Table 1: Groundwater Quality Parameters Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017) Annual MNA Report**

Geosyntec Consultants

Well ID	GM-01S									
Sample Date	3/10/2015	6/10/2015	10/6/2015	12/3/2015	3/23/2016	8/11/2016	10/19/2016	11/29/2016	5/4/2017	11/8/2017
Field Sample ID	GM-01S.20150310	GM-01S.20150610	GM-01S.20151006	GM-01S.20151203	GM-01S.20160323	GM-01S.20160811	GM-01S.20161019	GM-01S.20161129	GM-01S.20170504	GM-01S.20171108
pH	5.04	5.07	5.00	5.04	5.14	4.88	5.12	5.10	5.10	4.88
Dissolved oxygen (mg/L)	0.65	0.74	0.38	1.48	0.79	0.45	0.48	0.89	0.83	0.66
Oxidation-Reduction Potential (mV)	300.9	377.9	269.4	272.4	241.1	341.6	326.1	206.5	280.4	303.0
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	79	119	106	70	80,000	85	91	71	93	125
Temperature (°C)	13.64	14.97	14.73	14.15	14.06	15.66	15.66	14.31	14.38	14.2
Turbidity (NTU)	0.50	0.31	0.35	0.13	0.36	0.19	1.92	0.14	0.25	0.18

Well ID	GM-02S									
Sample Date	3/12/2015	6/10/2015	10/8/2015	12/3/2015	3/24/2016	8/9/2016	10/18/2016	11/30/2016	5/2/2017	11/7/2017
Field Sample ID	GM-02S.20150312	GM-02S.20150610	GM-02S.20151008	GM-02S.20151203	GM-02S.20160324	GM-02S.20160809	GM-02S.20161018	GM-02S.20161130	GM-02S.20170502	GM-02S.20171107
pH	6.23	5.88	5.60	5.83	5.12	5.64	5.38	5.75	5.43	5.78
Dissolved oxygen (mg/L)	2.03	0.92	0.68	0.89	0.80	0.56	0.56	0.35	0.65	0.41
Oxidation-Reduction Potential (mV)	99.2	160.9	208.6	266.2	95.2	258.6	241.5	160.4	165.7	240.7
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	1,527	421	270	222	414,000	290	313	240	435	352
Temperature (°C)	14.73	17.67	16.87	15.77	15.89	18.47	16.72	16.3	16.69	16.41
Turbidity (NTU)	12.40	0.98	0.19	0.85	0.37	1.21	0.63	8.38	1.21	0.00

Well ID	GM-03RS									
Sample Date	3/11/2015	6/9/2015	10/6/2015	11/30/2015	3/24/2016	8/9/2016	10/20/2016	11/29/2016	5/2/2017	11/7/2017
Field Sample ID	GM-03RS.20150311	GM-03RS.20150609	GM-03RS.20151006	GM-03RS.20151130	GM-03RS.20160324	GM-03RS.20160809	GM-03RS.20161020	GM-03RS.20161129	GM-03RS.20170502	GM-03RS.20171107
pH	5.22	5.13	4.96	4.94	4.93	4.55	7.69*	5.11	5.11	4.97
Dissolved oxygen (mg/L)	1.04	0.72	0.75	0.82	1.06	2.00	2.20	0.43	0.45	0.56
Oxidation-Reduction Potential (mV)	169.6	218.9	193.5	146.8	56.0	702.8	252.7	269.1	297.4	262.7
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	120	115	72	92	70	110	106	68	99	110
Temperature (°C)	13.95	16.50	15.92	13.71	14.65	25.22	15.58	14.42	15.09	13.82
Turbidity (NTU)	0.42	0.97	1.67	1.75	1.15	2.17	1.62	1.81	1.20	0.39

**Table 1: Groundwater Quality Parameters Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017) Annual MNA Report**

Geosyntec Consultants

Well ID	GM-05S									
Sample Date	3/10/2015	6/10/2015	10/8/2015	12/1/2015	3/24/2016	8/9/2016	10/18/2016	11/30/2016	5/2/2017	11/7/2017
Field Sample ID	GM-05S.20150310	GM-05S.20150610	GM-05S.20151008	GM-05S.20151201	GM-05S.20160324	GM-05S.20160809	GM-05S.20161018	GM-05S.20161130	GM-05S.20170502	GM-05S.20171107
<b>pH</b>										
pH	5.80	5.10	4.92	5.36	5.30	2.89*	5.09	5.32	5.47	5.38
Dissolved oxygen (mg/L)	3.55	4.38	4.30	3.20	3.09	3.87	2.48	1.37	0.63	0.78
Oxidation-Reduction Potential (mV)	196.9	240.8	237.0	282.6	87.8	690.9*	280.0	145.3	255.1	294.7
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	187	114	113	60	137	147	165	149	207	236
Temperature (°C)	14.38	16.02	15.75	14.96	15.03	15.84	15.81	15.32	15.31	15.22
Turbidity (NTU)	11.50	0.57	0.42	0.00	0.40	0.11	0.12	0.30	0.78	0.70

Well ID	GM-06S									
Sample Date	3/10/2015	6/10/2015	10/8/2015	12/1/2015	3/24/2016	8/9/2016	10/18/2016	11/30/2016	5/2/2017	11/7/2017
Field Sample ID	GM-06S.20150310	GM-06S.20150610	GM-06S.20151008	GM-06S.20151201	GM-06S.20160324	GM-06S.20160809	GM-06S.20161018	GM-06S.20161130	GM-06S.20170502	GM-06S.20171107
<b>pH</b>										
pH	5.59	5.52	5.66	5.41	5.36	5.53	5.59	5.58	5.25	5.56
Dissolved oxygen (mg/L)	0.70	0.72	0.41	0.50	0.52	0.59	0.38	0.53	0.92	0.21
Oxidation-Reduction Potential (mV)	200.5	188.2	207.8	227.0	487.2*	263.4	268.1	232.9	183.8	200.5
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	226	222	215	224	209	163	293	234	319	337
Temperature (°C)	14.18	15.51	14.99	14.66	14.8	16.95	15.36	14.82	15.19	14.73
Turbidity (NTU)	0.58	0.69	0.47	0.73	0.42	0.44	1.24	0.69	0.78	0.44

Well ID	GM-07S									
Sample Date	3/11/2015	6/9/2015	10/7/2015	12/2/2015	3/24/2016	8/10/2016	10/20/2016	12/1/2016	5/3/2017	11/9/2017
Field Sample ID	GM-07S.20150311	GM-07S.20150609	GM-07S.20151007	GM-07S.20151202	GM-07S.20160324	GM-07S.20160810	GM-07S.20161020	GM-07S.20161201	GM-07S.20170503	GM-07S.20171109
<b>pH</b>										
pH	4.54	4.78	4.36	4.55	3.50	3.77	4.36	4.41	3.89	3.98
Dissolved oxygen (mg/L)	2.50	1.80	3.95	1.44	2.42	2.65	2.36	2.33	1.07	2.50
Oxidation-Reduction Potential (mV)	317.2	217.0	264.1	357.4	128.0	273.8	422.1	333.5	308.3	394.8
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	337	369	433	357	378,000	537	522	168	303	389
Temperature (°C)	13.54	15.14	14.45	13.69	14.23	15.62	14.4	14.07	14.25	14.19
Turbidity (NTU)	2.97	0.82	5.57	5.90	3.80	6.21	2.87	3.23	13.50	3.42

**Table 1: Groundwater Quality Parameters Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017) Annual MNA Report**

Geosyntec Consultants

Well ID	GM-08S									
Sample Date	3/11/2015	6/9/2015	10/7/2015	12/2/2015	3/24/2016	8/10/2016	10/20/2016	12/1/2016	5/3/2017	11/8/2017
Field Sample ID	GM-08S.20150311	GM-08S.20150609	GM-08S.20151007	GM-08S.20151202	GM-08S.20160324	GM-08S.20160810	GM-08S.20161020	GM-08S.20161201	GM-08S.20170503	GM-08S.20171108
<b>pH</b>										
pH	6.29	6.30	6.41	6.06	5.74	5.20	5.95	5.87	5.87	5.65
Dissolved oxygen (mg/L)	2.54	1.16	1.01	1.00	0.87	0.71	0.60	1.17	0.30	0.47
Oxidation-Reduction Potential (mV)	-13.5	96.1	30.5	39.5	15.6	478.7	5.8	10.5	-2.3	45.4
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	116	148	87	79	100	96,000	132	82	205	169
Temperature (°C)	13.90	16.05	15.1	14.57	14.60	15.85	15.10	14.74	15.02	15.46
Turbidity (NTU)	29.70	14.00	8.52	9.69	5.92	6.38	0.00	5.23	7.45	5.55
Well ID	MW-01									
Sample Date	3/10/2015	6/10/2015	10/6/2015	12/3/2015	3/23/2016	8/10/2016	10/19/2016	11/29/2016	5/3/2017	11/8/2017
Field Sample ID	MW-01.20150310	MW-01.20150610	MW-01.20151006	MW-01.20151203	MW-01.20160323	MW-01.20160810	MW-01.20161019	MW-01.20161129	MW-01.20170503	MW-01.20171108
<b>pH</b>										
pH	5.71	5.62	5.66	5.75	5.42	4.68	5.46	5.15	5.61	5.81
Dissolved oxygen (mg/L)	1.45	1.51	0.55	2.18	1.06	0.64	0.73	0.41	2.77	0.70
Oxidation-Reduction Potential (mV)	223.8	293.8	266.6	204.6	446.2	574.0	375.1	215.2	222.9	284.6
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	160	145	152	110	119	171	127	197	144	176
Temperature (°C)	13.68	15.98	14.88	13.77	14.49	17.59	15.11	14.43	14.68	14.16
Turbidity (NTU)	0.41	0.24	0.15	0.14	0.58	0.38	0.54	0.35	1.03	0.00
Well ID	MW-02									
Sample Date	3/12/2015	6/10/2015	10/7/2015	12/3/2015	3/23/2016	8/10/2016	10/19/2016	11/29/2016	5/4/2017	11/8/2017
Field Sample ID	MW-02.20150312	MW-02.20150610	MW-02.20151007	MW-02.20151203	MW-02.20160323	MW-02.20160810	MW-02.20161019	MW-02.20161129	MW-02.20170504	MW-02.20171108
<b>pH</b>										
pH	5.36	5.38	5.36	5.35	4.73	5.29	4.34	4.88	5.09	5.28
Dissolved oxygen (mg/L)	1.81	2.66	0.60	0.72	0.56	0.41	0.42	0.11	2.36	2.27
Oxidation-Reduction Potential (mV)	97.7	314.7	220.0	191.0	-126.4	182.3	250.3	109.8	261.4	309.4
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	175	187	182	194	275,000	281	198	288	201	202
Temperature (°C)	12.98	16.28	15.50	13.27	17.38	17.75	15.20	14.56	14.97	14.17
Turbidity (NTU)	18.00	9.06	1.17	0.74	0.68	0.22	2.07	2.43	3.16	0.00

**Table 1: Groundwater Quality Parameters Summary**  
**Swope Oil and Chemical Company Superfund Site**  
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Well ID	MW-04									
Sample Date	3/10/2015	6/10/2015	10/6/2015	12/2/2015	3/23/2016	8/9/2016	10/19/2016	11/29/2016	5/3/2017	11/8/2017
Field Sample ID	MW-04.20150310	MW-04.20150610	MW-04.20151006	MW-04.20151202	MW-04.20160323	MW-04.20160809	MW-04.20161019	MW-04.20161129	MW-04.20170503	MW-04.20171108
<b>pH</b>										
pH	5.43	4.11	5.09	5.37	4.78	4.89	5.00	5.23	5.31	6.03
Dissolved oxygen (mg/L)	3.59	5.47	3.99	5.11	6.06	5.88	5.79	6.60	5.02	4.24
Oxidation-Reduction Potential (mV)	266.9	302.2	300.9	285.4	635.8	279.6	412.3	304.8	250.3	382.5
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	136	94	113	95	121	91	77	79	123	151
Temperature (°C)	14.02	16.94	15.86	14.48	16.63	16.57	15.57	14.91	15.17	14.68
Turbidity (NTU)	1.97	1.61	2.20	0.23	1.66	0.28	1.03	1.67	0.93	0.42

Well ID	MW-07									
Sample Date	3/11/2015	6/10/2015	10/6/2015	12/1/2015	3/23/2016	8/10/2016	10/19/2016	11/30/2016	5/3/2017	11/9/2017
Field Sample ID	MW-07.20150311	MW-07.20150610	MW-07.20151006	MW-07.20151201	MW-07.20160323	MW-07.20160810	MW-07.20161019	MW-07.20161130	MW-07.20170503	MW-07.20171109
<b>pH</b>										
pH	6.21	3.99	5.01	5.04	4.70	3.11	6.24	4.93	4.57	4.84
Dissolved oxygen (mg/L)	8.94	7.37	5.51	7.50	4.95	6.67	7.94	7.40	6.45	4.95
Oxidation-Reduction Potential (mV)	191.4	342.9	231.9	137.6	204.3	679.8*	324.1	306.4	313.3	308.9
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	31	123	130	44	116	123	79	97	131	152
Temperature (°C)	13.72	15.41	14.64	14.51	14.44	16.20	14.96	14.64	14.70	14.78
Turbidity (NTU)	17.50	1.31	1.65	1.22	0.88	1.54	3.82	0.83	0.95	0.00

Well ID	MW-095									
Sample Date	3/10/2015	6/9/2015	10/5/2015	12/2/2015	3/22/2016	8/11/2016	10/18/2016	11/30/2016	5/2/2017	11/7/2017
Field Sample ID	MW-095.20150310	MW-095.20150609	MW-095.20151005	MW-095.20151202	MW-095.20160322	MW-095.20160811	MW-095.20161018	MW-095.20161130	MW-095.20170502	MW-095.20171107
<b>pH</b>										
pH	6.40	5.97	7.22	6.32	6.05	3.94	5.69	5.58	5.42	6.20
Dissolved oxygen (mg/L)	0.69	0.89	0.64	0.91	1.22	0.79	1.02	0.72	0.75	1.88
Oxidation-Reduction Potential (mV)	-63.2	-30.2	13.6	-44.7	42.3	581.0*	159.9	84.0	101.6	143.2
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	411	343	317	144	212	295	201	160	222	225
Temperature (°C)	13.59	16.38	14.93	14.29	14.34	17.29	16.16	14.76	15.65	14.55
Turbidity (NTU)	6.09	19.9	7.54	8.61	7.14	2.84	6.34	7.63	5.63	6.21

**Table 1: Groundwater Quality Parameters Summary**  
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Well ID	MW-10S									
Sample Date	3/11/2015	6/9/2015	10/7/2015	12/2/2015	3/23/2016	8/10/2016	10/19/2016	12/1/2016	5/3/2017	11/8/2017
Field Sample ID	MW-10S.20150311	MW-10S.20150609	MW-10S.20151007	MW-10S.20151202	MW-10S.20160323	MW-10S.20160810	MW-10S.20161019	MW-10S.20161201	MW-10S.20170503	MW-10S.20171108
<b>pH</b>										
pH	4.35	4.60	4.71	4.79	4.29	4.36	4.70	4.53	4.26	4.63
Dissolved oxygen (mg/L)	6.45	4.91	6.51	2.00	2.04	7.13	3.82	2.42	7.20	6.69
Oxidation-Reduction Potential (mV)	372.0	422.9	242.2	241.7	206.6	382.0	405.5	264.4	245.9	313.7
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	404	254	444	108	132	552	163	173	143	233
Temperature (°C)	13.56	15.51	14.20	13.67	14.14	15.12	14.15	13.69	14.33	13.32
Turbidity (NTU)	0.56	0.31	0.26	0.23	0.14	0.36	0.87	0.46	2.65	0.18

Well ID	MW-11S									
Sample Date	3/11/2015	6/9/2015	10/8/2015	12/2/2015	3/22/2016	8/11/2016	10/18/2016	11/30/2016	5/2/2017	11/7/2017
Field Sample ID	MW-11S.20150311	MW-11S.20150609	MW-11S.20151008	MW-11S.20151202	MW-11S.20160322	MW-11S.20160811	MW-11S.20161018	MW-11S.20161130	MW-11S.20170502	MW-11S.20171107
<b>pH</b>										
pH	5.34	4.82	5.17	5.16	5.35	5.21	4.81	4.89	4.78	4.69
Dissolved oxygen (mg/L)	8.46	7.27	6.71	7.49	6.64	7.17	7.12	7.00	5.70	6.04
Oxidation-Reduction Potential (mV)	267.8	307.8	283.4	297.1	288.3	303.0	347.3	195.6	282.3	345.0
Specific Conductance ( $\mu\text{S}/\text{cm}$ )	76	72	58	38	55,000	64	89	117	159	176
Temperature (°C)	15.05	17.77	17.11	15.33	15.28	17.83	17.15	15.51	16.15	15.48
Turbidity (NTU)	4.22	2.75	4.07	18.40	1.07	0.76	0.15	0.64	0.41	0.00

**Notes:**

\*Value is out of range compared to the 2015-2016 dataset for this well and is considered an erroneous reading.

**Table 2: Shallow Aquifer Groundwater Elevation Data**  
**Swope Oil and Chemical Company Superfund Site**  
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Well ID	Well Diameter (in.)	Total Depth of Well (ft. bgs)	Screened Interval (ft. bgs)	Measuring Point Elevation (ft. MSL)	SA1			SA2		
					Date	Depth to Water (ft. btoic)	Potentiometric Surface Elevation (ft. MSL)	Date	Depth to Water (ft. btoic)	Potentiometric Surface Elevation (ft. MSL)
GM-01S	4	130	110-130	66.49	4/20/2017	72.14	-5.65	10/30/2017	72.31	-5.82
GM-02S	4	130	110-130	59.44	4/20/2017	64.91	-5.47	10/30/2017	65.14	-5.70
GM-03RS	4	130	110-130	69.46	4/20/2017	75.27	-5.81	10/30/2017	75.34	-5.88
GM-05S	4	127	107-127	51.51	4/20/2017	57.13	-5.62	10/30/2017	57.37	-5.86
GM-06S	4	130	110-130	60.19	4/20/2017	65.75	-5.56	10/30/2017	65.94	-5.75
GM-07S	4	130	110-130	65.37	4/20/2017	71.16	-5.79	10/30/2017	71.40	-6.03
GM-08S	4	130	110-130	69.67	4/20/2017	75.58	-5.91	10/30/2017	75.81	-6.14
MW-01	4	130	110-130	68.64	4/20/2017	74.31	-5.68	10/30/2017	74.47	-5.83
MW-02	4	102	77-102	69.02	4/20/2017	74.71	-5.69	10/30/2017	74.85	-5.83
MW-04	4	130	110-130	63.30	4/20/2017	69.01	-5.71	10/30/2017	69.20	-5.90
MW-07	4	115	95-115	69.77	4/20/2017	75.35	-5.58	10/30/2017	75.55	-5.78
MW-09S	4	130	120-130	69.57	4/20/2017	75.30	-5.73	10/30/2017	75.54	-5.97
MW-10S	4	133	123-133	70.81	4/20/2017	76.60	-5.79	10/30/2017	76.79	-5.98
MW-11S	4	127	117-127	69.56	4/20/2017	75.25	-5.69	10/30/2017	75.45	-5.89

**Notes:**

ft. - Feet

in. - Inches

bgs - Below ground surface

MSL - Mean sea level

SA - Semi-annual event

btoic - Below top of inner casing

Negative elevation values indicate values below mean sea level

**Table 3: Deep Aquifer Groundwater Elevation Data**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017) Annual MNA Report**

Geosyntec Consultants

Well ID	Well Diameter (in.)	Total Depth of Well (ft. bgs)	Screened Interval (ft. bgs)	Measuring Point Elevation (ft. MSL)	Date	Depth to Water (ft. BTOIC)	Potentiometric Surface Elevation (ft. MSL)	Date	Depth to Water (ft. BTOIC)	Potentiometric Surface Elevation (ft. MSL)
GM-01D	4	195	175-195	66.44	10/23/2017	72.81	-6.37	11/6/2017	72.48	-6.04
GM-02D	4	197	177-197	59.38	10/23/2017	65.50	-6.12	11/6/2017	65.30	-5.92
GM-03D	4	195	175-195	65.30	10/23/2017	71.81	-6.51	11/6/2017	71.60	-6.30
GM-04D	4	190	170-190	63.86	10/23/2017	70.37	-6.51	11/6/2017	70.10	-6.24
GM-05D	4	195	175-195	52.00	10/23/2017	58.45	-6.45	11/6/2017	58.28	-6.28
GM-06D	4	200	180-200	59.81	10/23/2017	65.92	-6.11	11/6/2017	65.75	-5.94
GM-07D	4	200	180-200	64.95	10/23/2017	71.71	-6.76	11/6/2017	71.40	-6.45
GM-08D	4	205	185-205	68.66	10/23/2017	75.78	-7.12	11/6/2017	75.40	-6.74

**Notes:**

ft. - Feet

in. - Inches

bgs - Below ground surface

MSL - Mean sea level

BTOIC - Below top of inner casing

Negative elevation values indicate values below mean sea level

**Table 4: Shallow Aquifer Analytical Data Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017)**

Well ID	Units	CASNumber	ROD Performance Standards	GM-01S											GM-02S											GM-03RS					
				3/10/2015	6/10/2015	10/6/2015	12/3/2015	3/23/2016	8/11/2016	10/19/2016	11/29/2016	5/4/2017	11/8/2017	3/12/2015	6/10/2015	10/8/2015	12/3/2015	3/24/2016	8/9/2016	10/18/2016	11/30/2016	5/2/2017	11/7/2017	3/11/2015	6/9/2015	10/6/2015	11/30/2015	3/24/2016			
Sample Date				GM-01S.20150310	GM-01S.20150610	GM-01S.20151006	GM-01S.20151203	GM-01S.20160323	GM-01S.20160811	GM-01S.20161019	GM-01S.20161129	GM-01S.20170504	GM-01S.20171108	GM-02S.20150312	GM-02S.20150610	GM-02S.20151008	GM-02S.20151203	GM-02S.20160324	GM-02S.20160809	GM-02S.20161018	GM-02S.20161130	GM-02S.20170502	GM-02S.20171107	GM-03RS.20150311	GM-03RS.20150609	GM-03RS.20151006	GM-03RS.20151130	GM-03RS.20160324			
Field Sample ID				Groundwater	Groundwater	Groundwater	Groundwater	Groundwater																							
Sample Matrix																															
<b>Dissolved Gases</b>																															
Ethane	µg/L	74-84-0		0.002 U	0.002 UJ	0.0025 J	0.1 U	0.002 U	0.003 U	0.003 U	0.003 U	0.1 U	0.025	0.002 U	0.002 U	0.1 U	0.002 U	0.003 U	0.007 U	0.003 U	0.1 U	0.1 U	0.002 U	0.002 U	0.019 J	0.1 U	0.002 U				
Ethene	µg/L	74-85-1		0.003 U	0.003 UJ	0.004 U	0.1 U	0.004 U	0.0035 J	0.29	0.001 U	0.1 U	0.026	0.003 U	0.004 U	0.1 U	0.004 U	0.001 U	0.009 U	0.001 U	0.1 U	0.1 U	0.033	0.003 U	0.004 U	0.1 U	0.004 U				
Methane	µg/L	74-82-8		0.042 U	0.74 J	0.037 U	1.2 J+	37	0.056 J	0.027 U	0.027 U	0.78	0.5 U	6.5	4.7 J+	9.3	4.2 J+	0.037 U	5.9 J	15	8	3.4 J+	17 J+	60	27	46	4.3	7.6			
<b>Metals</b>																															
Iron (Dissolved)	µg/L	7439-89-6		6.1	4	50 U	50 U	13.5	50 U	50 U	100 U	100 U	140	20.6	50 U	100 U	100 U	660	276	599	126	78.9									
Iron (Total)	µg/L	7439-89-6		12.3	5	50 U	50 U	16.9	50 U	50 U	100 U	100 U	908	29.5	50 U	50 U	9.6	50 U	50 U	503	25.1 J	30.6	667	336	665	171	109				
Manganese (Dissolved)	µg/L	7439-96-5		96.4	132	139	128	100	109	114	132	157	208	644	655	327	574	1,050	855	467	1,210	516	531	497	465	492					
Manganese (Total)	µg/L	7439-96-5		95.8	133	151	125	101	109	120	131	158	204	215	660	624	334	540	1,080	860	432	1,240	493	509	491	468	496				
<b>General Chemistry</b>																															
Alkalinity, Total	µg/L	ALK		4,400	4,700	5000 U	5000 U	7,000	3,200	7,200	5000 U	1,100	5000 U	54,900	44,100	29,400	45,200	21,000	19,400	31,200	37,400	33,200	30,900	10,300	8,400	9,100	7,700	10,500			
Nitrate	µg/L	14797-55-8		1,700	1,700	1,500	1,900	950	1,800	2,000	2,200	2,100	1,700	1,800	1,200	640	1,300	1,800	1,300	810	1,100	1,400	1000	53	260	250	290	330			
Nitrate and Nitrite	µg/L	OER-100-51		1,700	1,700	1,500	1,900	960	1,800	2,000	2,200	2,100	1,700	1,800	1,200	640	1,300	1,800	1,300	810	1,100	1,400	1000	55	260	250	290	340			
Nitrite	µg/L	14797-65-0		10 U	3.7	10 U	10 U	5.5	10 U	10 U	10 U	13																			
Sulfate	µg/L	14808-79-8		10,800	11,800	7,900	8,000	10,800	7,500	10000 U	10000 U	5,600	8,800	32,000	29,300	31,500	30,000	26,300	37,000	37,700	36,900	28,800	35,600	17,600	13,300	13,700	13,100	11,600			
Total Organic Carbon	µg/L			940	930	1000 U	1,900	1,400	1,100	1,000 U	1,100	900	1,100	1,200	1000	870	1,400	1,200	1000 U	1000 U											
Total Suspended Solids	mg/L	TSS		4 U	4	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	0.6	4 U	0.6	10	8	4 U	1.4	4 U	4 U	4.9	4 U	4 U	3	5	4 U	4 U		
<b>VOCs</b>																															
1,1,1-Trichloroethane	µg/L	71-55-6	30	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.2 J	0.21 J	0.23 J	0.26 J
1,1,2-Tetrachloroethane	µg/L	79-34-5	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	µg/L	79-00-5	3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	76-13-1	20000	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,1-Dichloroethane	µg/L	75-34-3	50	0.45 J	0.51 J	0.38 J	0.26 J	0.3 J	0.36 J	0.34 J	0.32 J	0.86 J	2	2.4	4.4	3	2.9	4.5	5.7	6.4	4.5	6.7	5.6	4.4	3.7	3	2.8				
1,1-Dichloroethene	µg/L	75-35-4	1	1 U																											

**Table 4: Shallow Aquifer Analytical Data Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017)**

Well ID	Units	CASNumber	ROD Performance Standards	GM-03RS					GM-05S										GM-06S											
				8/9/2016	10/20/2016	11/29/2016	5/2/2017	11/7/2017	3/10/2015	6/10/2015	10/8/2015	12/1/2015	3/24/2016	8/9/2016	10/18/2016	11/30/2016	5/2/2017	11/7/2017	3/10/2015	6/10/2015	10/8/2015	12/1/2015	3/24/2016	8/9/2016	10/18/2016	11/30/2016	5/2/2017			
Sample Date				GM-03RS,20160809	GM-03RS,20161020	GM-03RS,20161129	GM-03RS,20170502	GM-03RS,20171107	GM-05S,20150310	GM-05S,20150610	GM-05S,20151008	GM-05S,20151201	GM-05S,20160324	GM-05S,20161018	GM-05S,20161130	GM-05S,20170502	GM-05S,20171107	GM-06S,20150310	GM-06S,20150610	GM-06S,20151008	DUP-06S,20151201	GM-06S,20160324	GM-06S,20160809	GM-06S,20161018	GM-06S,20161130	GM-06S,20170502				
Field Sample ID				Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater			
Sample Matrix																														
<b>Dissolved Gases</b>																														
Ethane	µg/L	74-84-0		0.003 U	0.003 J	0.003 U	0.1 U	0.18	0.002 U	0.002 UJ	0.002 U	0.1 U	0.002 U	0.003 U	0.007 U	0.003 U	0.1 U	0.1 U	0.002 U	0.002 U	0.1 U	0.002 U	0.003 U	0.003 U	0.007 U	0.11	0.1 U			
Ethene	µg/L	74-85-1		0.001 U	0.001 J	0.001 U	0.1 U	0.1 U	0.003 U	0.003 UJ	0.004 U	0.1 U	0.004 U	0.001 U	0.009 U	0.001 U	0.1 U	0.1 U	0.003 U	0.003 U	0.1 U	0.004 U	0.001 U	0.001 U	0.009 U	0.001 U	0.1 U			
Methane	µg/L	74-82-8		22 J	4.7	2.6 J+	0.5 U	12 J+	0.042 U	0.042 UJ	0.037 U	0.5 U	0.037 U	0.027 U	0.027 U	0.027 U	0.5 U	0.5 U	0.36 J+	1.2 J+	1.1	1.8 J+	1.3	0.027 U	0.027 U	3.8	5	0.5 U		
<b>Metals</b>																														
Iron (Dissolved)	µg/L	7439-89-6		50 U	58	50 U	100 U	20.7	349	4.7	50 U	50 U	50 U	50 U	100 U	20.1 J	27.2	20.6	50 U	0.71	50 U	50 U	50 U	50 U	50 U	100 U				
Iron (Total)	µg/L	7439-89-6		135	86.9	200	19.5 J	30.4	542	11.7	50 U	21.6	5	50 U	50 U	100 U	20 UJ	38.2	25.2	50 U	7.2	6.4	50 U	50 U	50 U	50 U	19.3 J			
Manganese (Dissolved)	µg/L	7439-96-5		488	441	482	494	534	50.2	20.4	101	81.7	126	150	144	235	472	635	416	418	491 J+	689	683	707	1,300	1,460	1,820			
Manganese (Total)	µg/L	7439-96-5		523	470	457	483	533	50.2	21	77.1	95.3	81.9	128	146	125	244	480	641	405	404	500 J+	682	769	768	1,360	1,430	1,960		
<b>General Chemistry</b>																														
Alkalinity, Total	µg/L	ALK		5000 U	25,500	3,200	3,700	10,200	13,100	5,000 U	3,300	2,200	11,600	13,400	21,600	24,200	6,800	25,500	21,000	11,300	10,800	20,600	15,100	19,900						
Nitrate	µg/L	14797-55-8		150	570	540	730	1,300	2,600	3,500	1,900 J	2,400	2,500	2,500	2,200	1,600	1,700	1,300	1,000 J	1,500	1,600	2,800	2,700	840	700	740				
Nitrate and Nitrite	µg/L	OER-100-51		160	570	540	730	1,300	2,600	3,500	1,900 J	2,400	2,500	2,500	2,200	1,600	1,700	1,300	1,000 J	1,500	1,600	2,800	2,700	840	700	740				
Nitrite	µg/L	14797-65-0		7.1	10 U	10 U	10 U	4.5	10 U	3.7	10 U	10 U	12	10 U	11	10 U	10 U													
Sulfate	µg/L	14808-79-8		12,500	13,600	14,300	12,100	14,200	18,500	13,800	16,500	26,300	23,800	22,500	29,200	33,500	36,500	53,400	18,400	27,900	26,600	29,300	25,800	21,200	21,200	42,300	44,000	34,000		
Total Organic Carbon	µg/L			400	1000 U	1000 U	440 J	1000 U	4,500	900	1000 U	1000 U	410	300	1000 UJ	700 J	980	1,100	980	1000 U	1000 U	1000	370	340	330	1000	640			
Total Suspended Solids	mg/L	TSS		4 U	4 U	1	4 U	4 U	2	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	2	4 U	4 U	4 U	4 U	4 U	4 U	4 U			
<b>VOCs</b>																														
1,1,1-Trichloroethane	µg/L	71-55-6	30	0.38 J	0.33 J	1 U	0.35 J	1 U	0.27 J	0.19 J	0.21 J	0.22 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U		
1,1,2-Tetrachloroethane	µg/L	79-34-5	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U		
1,1,2-Trichloroethane	µg/L	79-00-5	3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U		
1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	76-13-1	20000	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U		
1,1-Dichloroethane	µg/L	75-34-3	50	3.2	2.5	2.7	2.1	2.7	0.79 J	0.71 J	2.8	2.8	2.8	2.9	2.7	3.1	2.5	1.9	0.56 J	0.64 J	1.1	1.1	1.3	1.3	2.7	3.4	2.9			
1,1-Dichloroethene	µg/L	75-35-4	1	0.46 J	0.49 J	0.53 J	0.57 J	0.67 J	0.37 J	0.23 J	0.62 J	0.63 J	0.65 J	0.58 J	0.5															

**Table 4: Shallow Aquifer Analytical Data Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017)**

Well ID	Units	CASNumber	ROD Performance Standards	GM-06S												GM-07S												GM-08S			
				11/7/2017	3/11/2015	6/9/2015	10/7/2015	10/7/2015	12/2/2015	3/24/2016	8/10/2016	10/20/2016	12/1/2016	5/3/2017	11/9/2017	3/11/2015	6/9/2015	10/7/2015	12/2/2015	3/24/2016	8/10/2016	10/20/2016	12/1/2016	5/3/2017	11/8/2017	3/10/2015	6/10/2015	10/6/2015			
Sample Date				GM-06S	GM-06S	GM-06S	DUP-	GM-06S	GM-07S	GM-08S	GM-08S	GM-08S	MW-01	MW-01	MW-01																
Field Sample ID				06S.20171107	07S.20150311	07S.20150609	01.20151007	07S.20151007	07S.20151202	07S.20160324	07S.20160810	07S.20161020	07S.20161201	07S.20170503	07S.20171109	08S.20150311	08S.20150609	08S.20151007	08S.20151202	08S.20160324	08S.20160810	08S.20161020	08S.20161201	08S.20170503	08S.20171108	01.20150310	01.20150610	01.20151006			
Sample Matrix				Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	
<b>Dissolved Gases</b>																															
Ethane	µg/L	74-84-0		0.1 U	0.002 U	0.002 U	0.14 J	0.002 UJ	0.1 U	0.002 U	0.0072 J	0.003 J	0.003 U	0.1 U	0.1 U	0.002 U	0.002 U	0.002 U	0.1 U	0.002 U	0.003 U	0.003 J	0.003 U	0.1 U	0.1 U	0.002 U	0.002 U	0.014 J			
Ethene	µg/L	74-85-1		0.1 U	0.003 U	0.003 U	0.004 U	0.017 J	0.004 U	0.018 J	0.001 J	0.001 U	0.1 U	0.1 U	0.003 U	0.003 U	0.004 U	0.13	0.004 U	0.001 U	0.47	0.62	0.76	0.62	0.003 U	0.003 U	0.004 U				
Methane	µg/L	74-82-8		2.2 U	0.47 J+	0.66	5.9	5.1	9.8	2.7	3	6.6	8.7	20	46	2	2.2	3.9	30	10 J+	43	55	110	74	7.3	20	14				
<b>Metals</b>																															
Iron (Dissolved)	µg/L	7439-89-6		100 U	88.3	20.6	81	80.4	88.9	109	119	50 U	1,060	550	3,040	590	4,110	5,230	8,880	5,920	12,600	12,100	23,100	19,400	8	2.7	50 U				
Iron (Total)	µg/L	7439-89-6		100 U	136	58.1	237	247	258	242	266	111	1,650	620	4,900	1,350	4,410	5,350	8,620	5,900	12,700	12,000	24,000	19,000	6.4	2.3	50 U				
Manganese (Dissolved)	µg/L	7439-96-5		2,100	2,930	3,450	3,050	3,200	2,990	2,970	2,610	2,600	2,230	2,600	1,820	411	506	463	566	707	544	671	787	1,120	942	600	424	574			
Manganese (Total)	µg/L	7439-96-5		2,100	2,980	3,380	3,080	3,320	2,970	3,040	2,680	2,430	2,210	2,910	409	517	442	589	678	547	694	759	1,150	931	606	439	589				
<b>General Chemistry</b>																															
Alkalinity, Total	µg/L	ALK		22,700	2,900	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	5000 U	33,300	34,700	24,200	10,200	22,100	15,100	24,500	13,900	24,900	3,600	29,400	26,300	32,100			
Nitrate	µg/L	14797-55-8		860	610	760	600	580	1800 U	930	1,100	820 J+	1,100	1,100	120	48	32	1500 U	110 U	68	330	110 U	110 U	110 U	360	850	430				
Nitrate and Nitrite	µg/L	OER-100-51		860	610	760	600	580	1800 U	940	1,100	820 J+	1,100	1,100	120	48	32	1500 U	100 U	68	330	100 U	100 U	100 U	360	860	430				
Nitrite	µg/L	14797-65-0		10 U	10 U	10 U	2 U	2 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U			
Sulfate	µg/L	14808-79-8		35,100	28,600	21,300	21,700	21,100	22,600	2,200	20,000	24,800	23,400	21,700	30,700	15,800	11,700	10,100	13,200	11,300	9,400	16,000	18,300	17,600	27,700	11,500	15,200	11,600			
Total Organic Carbon	µg/L			780	1000	940	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	510	620 J	610	920	900	1000 U		
Total Suspended Solids	mg/L	TSS		4 U	4 U	4 U	2.4	1.8	2	2.3	1.2	4 U	0.6	4 U	4 U	6	9	3.6	3.2	4 U	2	4 U	1.8	2.4 J	2	2	4 U	4 U			
<b>VOCs</b>																															
1,1,1-Trichloroethane	µg/L	71-55-6	30	1 U	0.27 J	0.18 J	1 U	0.16 J	0.21 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.22 J	1 U	1 U	
1,1,2,2-Tetrachloroethane	µg/L	79-34-5	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	µg/L	79-00-5	3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	76-13-1	20000	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,1-Dichloroethane	µg/L	75-34-3	50	2.4	1.6	1.2	1.6	1.6	1.7	1.1</																					

**Table 4: Shallow Aquifer Analytical Data Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017)**

Well ID	Units	CASNumber	ROD Performance Standards	MW-01								MW-02								MW-04											
				12/3/2015	3/23/2016	8/10/2016	10/19/2016	11/29/2016	5/3/2017	11/8/2017	3/12/2015	6/10/2015	10/7/2015	12/3/2015	3/23/2016	8/10/2016	10/19/2016	11/29/2016	5/4/2017	11/8/2017	3/10/2015	6/10/2015	10/6/2015	12/2/2015	3/23/2016	8/9/2016	10/19/2016	11/29/2016			
Sample Date				MW-01.20151203	MW-01.20160323	MW-01.20160810	MW-01.20161019	MW-01.20161129	MW-01.20170503	MW-01.20171108	MW-02.20150312	MW-02.20150610	MW-02.20151007	MW-02.20151203	MW-02.20160323	MW-02.20160810	MW-02.20161019	MW-02.20161129	MW-02.20170504	MW-02.20171108	MW-04.20150310	MW-04.20150610	MW-04.20151006	MW-04.20151202	MW-04.20160323	MW-04.20160809	MW-04.20161019	MW-04.20161129			
Field Sample ID				Groundwater																											
Dissolved Gases																															
Ethane	µg/L	74-84-0		0.1 U	0.002 U	0.003 U	0.003 J	0.003 U	0.1 U	0.002 U	0.002 U	0.1 U	0.002 U	0.003 U	0.003 U	0.16	0.1 U	0.002 U	0.002 U	0.0053 J	0.1 U	0.002 U	0.003 U	0.26	0.003 U						
Ethene	µg/L	74-85-1		0.1 U	0.004 U	0.001 U	0.001 J	0.001 U	0.1 U	0.003 U	0.003 U	0.004 U	0.1 U	0.004 U	0.001 U	0.001 U	0.1 U	0.003 U	0.003 U	0.004 U	0.013 J	0.004 U	0.001 U	0.14	0.001 U						
Methane	µg/L	74-82-8		11	11	16 J+	8.6	5.3 J+	1	0.78 U	1.1 J+	0.042 U	1.7	1.6 J+	200	240 J+	290	230	0.5 U	0.95 J+	0.042 U	0.037 U	0.5 U	0.037 U	0.027 U	1.4	0.027 U				
Metals																															
Iron (Dissolved)	µg/L	7439-89-6		50 U	4	50 U	50 U	100 U	20 U	18.6	27.6	631	162	2,280	4,240	3,940	2,850	63.2	56.3	4.9	3.9	50 U	50 U								
Iron (Total)	µg/L	7439-89-6		64.3	4.3	50 U	50 U	31.5 J	100 U	1,800	984	582	128	2,230	4,270	3,820	3,010	173	70.4	3,880	54.6	63.6	50 U	50 U	50 U						
Manganese (Dissolved)	µg/L	7439-96-5		471	418	368	326	318	333 S	314	747	675	759	697	787	1,170	1,260	1,190	1,000	874	36.1	76.7	41.4	50	51.9	60.8	58	66.3 J+			
Manganese (Total)	µg/L	7439-96-5		478	407	344	331	322	340 S	313	740	669	753	666	812	1,100	1,180	1,130	956	870	1,840	81	48.2	50.1	59.7	63	59.6	71.5 J+			
General Chemistry																															
Alkalinity, Total	µg/L	ALK		34,700	26,000	30,200	29,000	21,700	18,800	10,800	23,000	24,200	25,700	19,100	22,500	9,700	29,000	7,800	10,500	5000 U	21,100	4,700	8,600	1,500	10,000	3,800	7,200	5000 U			
Nitrate	µg/L	14797-55-8		530	540	830	1000	1,100	1,600	1,200	110 U	26	150 J	110 U	110 U	68	71	190	130	120	2,500	2,800	2,700	110 U	3,200	3,900	3,700	3,500			
Nitrate and Nitrite	µg/L	OER-100-51		530	540	830	1000	1,100	1,600	1,200	100 U	29	150 J	77	100 U	68	100 U	190	130	120	2,500	2,800	2,700	100 U	3,200	3,900	3,700	3,500			
Nitrite	µg/L	14797-65-0		10 U	3.5	2 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5.3	10 U	10 U														
Sulfate	µg/L	14808-79-8		12,400	13,400	14,600	18,000	16,500	7,700	9,900	19,300	18,500	31,000	34,200	35,400	38,600	46,900	45,700	27,700	26,500	13,600	13,900	12,400	12,800	12,500	11,300	13,600	12,800			
Total Organic Carbon	µg/L			1000 U	340 J	1000 U	1,800	1,300	1,300	1,100	1,400	1,200	790	1,600	900	1000	960	1000	1000 U	1000 U	1000 U										
Total Suspended Solids	mg/L	TSS		4 U	4 U	4 U	4 U	4 U	4 U	4 U	5	4 U	4 U	4 U	4 U	1	4 U	0.8	4 U	5	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	
VOCs																															
1,1,1-Trichloroethane	µg/L	71-55-6	30	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.98 J	0.56 J	0.43 J	0.36 J	0.33 J	0.21 J	1 U	0.26 J	1 U	1 U	0.23 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.51 J	
1,1,2,2-Tetrachloroethane	µg/L	79-34-5	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	
1,1,2-Trichloroethane	µg/L	79-00-5	3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.76 J	0.69 J	0.82 J	0.8 J	0.84 J	0.85 J	0.84 J	0.97 J	0.72 J	0.76 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	
1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	76-13-1	20000	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	
1,1-Dichloroethane	µg/L	75-34-3	50	0.54 J	0.9 J	1	1.2	1.2	0.9 J	0.98 J	7.3	5	5.5	4.3	4.5	4.4	3.6	3.9	2.4	2.3	0.24 J	0.17 J	1 U	1 U	0.26 J	0.23 J	1 U	0.49 J			
1,1																															

**Table 4: Shallow Aquifer Analytical Data Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017)**

Well ID	Units	CASNumber	ROD Performance Standards	MW-04				MW-07												MW-09S												MW-10S			
				5/3/2017	11/8/2017	3/11/2015	6/10/2015	10/6/2015	12/1/2015	12/1/2015	3/23/2016	8/10/2016	10/19/2016	11/30/2016	5/3/2017	11/9/2017	3/10/2015	6/9/2015	10/5/2015	12/2/2015	3/22/2016	8/11/2016	10/18/2016	11/30/2016	5/2/2017	11/7/2017	3/11/2015	6/9/2015							
Sample Date				MW-04.20170503	MW-04.20171108	MW-07.20150311	MW-07.20150610	MW-07.20151006	DUP-01.20151201	MW-07.20160323	MW-07.20160810	MW-07.20161019	MW-07.20170503	MW-07-20171109	MW-09S.20150310	MW-09S.20150609	MW-09S.20151005	MW-09S.20151202	MW-09S.20160322	MW-09S.20160811	MW-09S.20161018	MW-09S.20161103	MW-09S.20170502	MW-09S.20171107	MW-10S.20150311	MW-10S.20150609									
Field Sample ID				Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater						
Sample Matrix																																			
<b>Dissolved Gases</b>																																			
Ethane	µg/L	74-84-0		0.1 U	0.1 U	0.002 U	0.002 U	0.0078 J	0.1 U	0.1 U	0.002 U	0.003 J	0.003 J	0.003 U	0.1 U	0.1 U	0.002 U	0.002 U	0.1 U	0.002 U	0.028 J	0.003 U	0.003 U	0.1 U	0.13	0.002 U	0.002 U								
Ethene	µg/L	74-85-1		0.1 U	0.1 U	0.003 U	0.003 U	0.004 U	0.1 U	0.1 U	0.004 U	0.001 J	0.001 U	0.1 U	0.1 U	0.48	0.38	0.004 U	0.17	0.004 U	0.36	0.001 U	0.15	0.1 U	0.14	0.047	0.003 U								
Methane	µg/L	74-82-8		0.5 U	0.5 U	0.042 U	0.042 U	0.037 U	0.5 U	0.5 U	8.8	0.027 U	0.027 J	0.027 U	0.5 U	94	64	38	32	38	100	24	14	2.8 J+	8.9 J+	0.23 J+	0.042 U								
<b>Metals</b>																																			
Iron (Dissolved)	µg/L	7439-89-6		100 U	20 U	29.6	2.4	50 U	50 U	50 U	3.8	50 U	5.2	100 U	20 U	48,700	31,800	25,800	17,500	14,300	27,400	12,100	7,510	5,850	3,630	50 U	7.2								
Iron (Total)	µg/L	7439-89-6		43.4 J	100 U	469	35.8	86	25.7	29.4	27	31.8	59	16.4	100 U	100 U	46,900	29,800	25,100	15,300	14,300 J+	27,700	12,500	7,500	5,910	4,550	50 U	2.8							
Manganese (Dissolved)	µg/L	7439-96-5		60	72.7	2.9	47.8	48.5	43.1	41.5	53.4	51.2	52.2	65.1	69.2 S	97.2	366	425	515	305	233	570	249	273	199	443	322								
Manganese (Total)	µg/L	7439-96-5		71	72.5	6.7	55.3	52.4	45.5	44.1	61.4	54.1	58.8	71	73.1 S	100	361	392	497	275	231	568	253	288	272	204	436	313							
<b>General Chemistry</b>																																			
Alkalinity, Total	µg/L	ALK		3,900 J	5000 U	6,900	5000 U	5000 U	13000 U	13000 U	10000 U	5000 U	5000 U	5000 U	5000 U	43,600	95,800	53,800	51,000	42,500	51,800	34,000	24,500	29,300	51,000	5000 U	5000 U								
Nitrate	µg/L	14797-55-8		3,500 J-	3,400	94	1,800	1,700	2,300	2,200	2,300	2,600	2,200	2,500	110 U	87	140	110 U	180	110 U	370	380	220	140	1,800	1,500									
Nitrate and Nitrite	µg/L	OER-100-51		3,500 J-	3,400	96	1,800	1,700	2,300	2,200	2,300	2,600	2,200	2,500	100 U	87	140	100 U	180	110 U	370	380	220	140	1,800	1,500									
Nitrite	µg/L	14797-65-0		10 U	10 U	2.4	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U							
Sulfate	µg/L	14808-79-8		11,800	12,400	1,700	4,800	2,700	1,600	2,000	10000 U	2,500	1,800 J	1,800	30,800	30,200	34,400	19,300	16,000	25,200	19,400	20,300	14,800	19,000	24,800	18,300									
Total Organic Carbon	µg/L			530 J	620	3,800	740	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	460 J	1000 U	1,800	1,100	1,200	1,000 U	1,000 U	450	1000 U	410 J	720	1000	900									
Total Suspended Solids	mg/L	TSS		2	4 U	12	4 U	3.2	1.8 J	4 UJ	1.4	0.6	3.8	1	1.2 J	4 U	28	33	4.8	4.8	4 U	6.8	3.2	1.3 J	4.3	4 U	4 U								
<b>VOCs</b>																																			
1,1,1-Trichloroethane	µg/L	71-55-6	30	1 U	1.3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.31 J	0.39 J						
1,1,2,2-Tetrachloroethane	µg/L	79-34-5	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U						
1,1,2-Trichloroethane	µg/L	79-00-5	3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U						
1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	76-13-1	20000	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U						
1,1-Dichloroethane	µg/L	75-34-3	50	0.33 J	1.9	1 U	0.31 J	0.38 J	0.3 J	0.33 J	0.28 J	0.3 J	0.28 J	0.23 J	1 U	4.6	2.2	2.8	1.3	1.2	3.8	1.5	1.1	1.2	0.86 J	0.63 J									
1,1-Dichloroethene	µg/L	75-35-4	1	1 U	1 U	1 U																													

**Table 4: Shallow Aquifer Analytical Data Summary  
Woppe Oil and Chemical Company Superfund Site  
Year 3 (2017)**

Well ID	Units	CASNumber	ROD Performance Standards	MW-10S									MW-11S																		
Sample Date				10/7/2015	12/2/2015	3/23/2016	8/10/2016	10/19/2016	12/1/2016	5/3/2017	11/8/2017	3/11/2015	3/11/2015	6/9/2015	6/9/2015	10/8/2015	12/2/2015	3/22/2016	3/22/2016	8/11/2016	10/18/2016	10/18/2016	11/30/2016	11/30/2016	5/2/2017	5/2/2017	11/7/2017	11/7/2017			
Field Sample ID				MW-10S.20151007	MW-10S.20151202	MW-10S.20160323	MW-10S.20160810	MW-10S.20161019	MW-10S.20161201	MW-10S.20170503	MW-10S.20171108	DUP-01.20150311	MW-11S.20150311	DUP-01.20150609	MW-11S.20150609	MW-11S.20150088	DUP-01.20160108	MW-11S.20151202	DUP-01.20160322	MW-11S.20160811	DUP-01.20161018	MW-11S.20161018	DUP-01.20161130	MW-11S.20161130	DUP-01.20170502	MW-11S.20171107	DUP-01.20171107	MW-11S.20171107			
Sample Matrix				Groundwater																											
<b>Dissolved Gases</b>																															
Ethane	µg/L	74-84-0			0.002 U	0.1 U	0.002 U	0.007 U	0.003 J	0.003 U	0.1 U	0.1 U	0.002 U	0.002 U	0.002 U	0.002 U	0.1 U	0.002 U	0.002 U	0.003 U	0.003 U	0.003 U	0.003 U	0.1 U	0.003 U	0.003 U	0.003 U	0.003 U			
Ethene	µg/L	74-85-1			0.004 U	0.087 J	0.004 U	0.03 J	0.11	0.11	0.1 U	0.1 U	0.037	0.038	0.003 U	0.004 U	0.044 J	0.004 U	0.004 U	0.092 J	0.001 U	0.001 U	0.001 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		
Methane	µg/L	74-82-8			1.6	0.5 U	0.037 U	0.027 U	0.027 J	0.027 U	0.5 U	0.5 U	0.042 U	0.042 U	0.042 U	0.042 U	6.1	0.5 U	0.037 U	0.1 J	0.027 U	0.027 U	0.027 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U			
<b>Metals</b>																															
Iron (Dissolved)	µg/L	7439-89-6			50 U	100 U	20 U	50 U	3.9	1.5	1.7	50 U	50 U	50 U	50 U	50 UJ	50 U	50 U	2.7	100 U											
Iron (Total)	µg/L	7439-89-6			50 U	100 U	100 U	105	102	4.4	5.5	50 U	82.7	50 U	11.7	36.3 J	100 UJ	100 U	100 U	100 U											
Manganese (Dissolved)	µg/L	7439-96-5			540	234	260	540	267	228	373	392	16.1	16.3	26.8	27.1	21.2	17.9	18	16.9	20.7	22.4	23.2	37.9 J+	51.4	53.8	49.7	47.8			
Manganese (Total)	µg/L	7439-96-5			566	242	262	567	228	396	392	24.6	25	26.8	27.3	34.1	35.9	27.5	28.1	26.3	23.3	23.2	41.6 J+	41.5 J+	55.3	53.9	49.4	48.9			
<b>General Chemistry</b>																															
Alkalinity, Total	µg/L	ALK			5000 U	5000 U	4,500	5000 U	5000 U	5000 U	5000 U	4,900	3,400	3,200	2,100	5000 U	5000 U	5000 U	5000 U	4,300	5000 U	5000 U									
Nitrate	µg/L	14797-55-8			1,100 J	110 U	1,600	1,300	1,800	1,900	2,800	2,400	1,400	1,300	2,000	2,000	1,500	800 U	1,400	1,400	1,900	1,900	1,600	1,700	2,300	2,600	2,600	2,600	2,600		
Nitrate and Nitrite	µg/L	OER-100-51			1,100 J	100 U	1,600	1,300	1,800	1,900	2,800	2,400	1,400	1,300	2,000	2,000	1,500	800 U	1,400	1,400	1,900	1,900	1,600	1,700	2,300	2,600	2,600	2,600	2,600		
Nitrite	µg/L	14797-65-0			2 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	4 UJ	4.7 J			
Sulfate	µg/L	14808-79-8			18,900	21,900	17,700	18,500	25,100	21,200	23,200	5,500	5,700	4,100	4,100	10000 U	4,300	3,600	3,500	4,200	6,500	4,500	3,800	2,500	2,600	2,600	2,600	2,600	2,600	2,600	2,600
Total Organic Carbon	µg/L				1,100	1,100	1000 U	1000 U	1000 U	460	340 J	1000 U	920	890	620	610	1000 U	390 J	320 J	600 UJ	690 J										
Total Suspended Solids	mg/L	TSS			1.2	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U			
<b>VOCs</b>																															
1,1,1-Trichloroethane	µg/L	71-55-6	30	0.29 J	0.5 J	0.62 J	1 U	0.77 J	0.59 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.26 J	1 UJ	1 U	1 U	1 U	1 U		
1,1,2,2-Tetrachloroethane	µg/L	79-34-5	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	
1,1,2-Trichloroethane	µg/L	79-00-5	3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	
1,1,2,Trichlorotrifluoroethane (Freon 113)	µg/L	76-13-1	20000	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	
1,1-Dichloroethane	µg/L	75-34-3	50	0.82 J	0.83 J	0.93 J	0.59 J	0.95 J	0.85 J	0.23 J	1 U	2.5	2.4	1.9	1.7	2.6	2.5	2.2	2.7	1.5	1.7	0.96 J	1.1 J	0.56 J	0.52 J	0.36 J	1 UJ	1 U	1 U	1 U	
1,1-Dichloroethene	µg/L	75-35-4	1	0.53 J	0.84 J	1	0.4 J	1.4	1.4	0.23 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene	µg/L	120-82-1	9	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,2-Dibromo-3-chloropropane	µg/L	96-12-8	0.02	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,2-Dibromoethane	µg/L	106-93-4	0.03	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	µg/L	95-50-1	600	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	µg/L	107-06-2	2	1.1	0.77 J	0.57 J	0.74 J	0.44 J	1 U	1 U	1 U	1 U	0.61 J	0.67 J	1.2	1.2	0.92 J	0.75 J	0.68 J	0.67 J	0.95 J	0.5 J	0.53 J	0.32 J	0.32 J	1 U	1 U	1 U	1 U		

## Notes

Concentrations which exceed the ROD Performance Standards are highlighted blue

For some parameters the laboratory reporting limit exceeds the ROD Performance Standard. In cases where the laboratory reporting limit exceeds the ROD Performance Standard, and the parameter was not detected at above the laboratory reporting limit, the value reported is the laboratory reporting limit and it is *italicized and brown*.

#### I: Estimated value

U: Not detected above the laboratory reporting limit

J+: The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J-: The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

**Table 5: Deep Aquifer Analytical Data Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017) Annual MNA Report**

**Geosyntec Consultants**

Well ID	Units	CASNumber	ROD Performance Standards	GM-01D				
				10/26/2015	10/19/2016	10/19/2016	11/6/2017	11/6/2017
				GM-1D.20151026	DUP-02.20161019	GM-01D.20161019	DUP-02.20171106	GM-01D.20171106
Sample Matrix				Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
<b>VOCs</b>								
1,1,1-Trichloroethane	µg/L	71-55-6	30	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	79-34-5	1	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	µg/L	79-00-5	3	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	76-13-1	20000	2 U	2 U	2 U	2 U	2 U
1,1-Dichloroethane	µg/L	75-34-3	50	1.1	1	1	1 J	0.99 J
1,1-Dichloroethene	µg/L	75-35-4	1	0.23 J	0.31 J	0.34 J	1 U	1 U
1,2,4-Trichlorobenzene	µg/L	120-82-1	9	2 U	2 U	2 U	2 U	2 U
1,2-Dibromo-3-chloropropane	µg/L	96-12-8	0.02	2 U	2 U	2 U	2 U	2 U
1,2-Dibromoethane	µg/L	106-93-4	0.03	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	µg/L	95-50-1	600	0.39 J	1 UJ	0.27 J	1 U	1 U
1,2-Dichloroethane	µg/L	107-06-2	2	0.9 J	0.74 J	0.91 J	1 U	1 U
1,2-Dichloropropane	µg/L	78-87-5	1	0.32 J	1 U	1 U	0.36 UJ	0.37 J
1,3-Dichlorobenzene	µg/L	541-73-1	600	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	µg/L	106-46-7	75	0.89 J	0.41 J	0.45 J	1 U	1 U
2-Hexanone	µg/L	591-78-6	300	5 U	5 U	5 U	5 U	5 U
Acetone	µg/L	67-64-1	6000	5 U	37.5	34.7	5.7	5
Benzene	µg/L	71-43-2	1	1.9	1.4	1.5	0.58 J	0.55 J
Bromoform	µg/L	75-25-2	4	1 U	1 U	1 U	1 U	1 U
Bromomethane	µg/L	74-83-9	10	1 U	1 U	1 U	1 U	1 U
Carbon disulfide	µg/L	75-15-0	700	1 U	1 U	1 U	1 U	1 U
Carbon tetrachloride	µg/L	56-23-5	1	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	µg/L	108-90-7	50	0.94 J	2	1.9	1.2	1.2
Chloroethane	µg/L	75-00-3	5	1 U	1 U	1 U	1 U	1 U
Chloroform	µg/L	67-66-3	70	0.3 J	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	µg/L	156-59-2	70	2.9	3.4	3.2	3.5	3.5
Dibromochloromethane	µg/L	124-48-1	1	1 U	1 U	1 U	1 U	1 U
Dichlorodifluoromethane	µg/L	75-71-8	1000	2 U	2 U	2 U	2 U	2 U
Ethylbenzene	µg/L	100-41-4	700	1 U	1 U	1 U	1 U	1 U
Isopropylbenzene	µg/L	98-82-8	700	1 U	1 U	1 U	1 U	1 U
Methyl acetate	µg/L	79-20-9	7000	5 U	5 U	5 U	5 U	5 U
Methyl ethyl ketone (2-Butanone)	µg/L	78-93-3	300	5 U	5 U	5 U	5 U	5 U
Methyl tert butyl ether	µg/L	1634-04-4	70	12.8	1.3	1.5	1.6	1.5
Methylene chloride	µg/L	75-09-2	3	1 U	1 U	1 U	1 U	1 U
Styrene	µg/L	100-42-5	100	2 U	2 U	2 U	2 U	2 U
Tetrachloroethene	µg/L	127-18-4	1	0.79 J	0.47 J	0.46 J	1 U	1 U
Toluene	µg/L	108-88-3	600	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	156-60-5	100	1 U	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	79-01-6	1	0.79 J	0.81 J	0.74 J	0.48 J	0.48 J
Trichlorofluoromethane	µg/L	75-69-4	2000	2 U	2 U	2 U	2 U	2 U
Vinyl Chloride	µg/L	75-01-4	1	1 U	1 U	1 U	1 U	1 U
Xylene (Total)	µg/L	1330-20-7	1000	1 U	1 U	1 U	1 U	1 U

**Notes:**

-- Not analyzed

Concentrations which exceed the ROD Performance Standard are highlighted

blue

For some parameters the laboratory reporting limit exceeds the ROD Performance Standard. In cases where the laboratory reporting limit exceeds the ROD Performance Standard, and the parameter was not detected above the laboratory reporting limit, the value reported is the laboratory reporting limit and it is *italicized and brown*

J - Estimated value

U - Not detected above the laboratory reporting limit

**Table 5: Deep Aquifer Analytical Data Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017) Annual MNA Report**

**Geosyntec Consultants**

Well ID	Units	CASNumber	ROD Performance Standards	GM-02D			GM-03D		
				10/8/2015	10/18/2016	11/6/2017	10/7/2015	10/18/2016	11/6/2017
				GM-2D.20151008	GM-02D.20161018	GM-02D.20171106	GM-3D.20151007	GM-03D.20161018	GM-03D.20171106
Sample Matrix				Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
<b>VOCs</b>									
1,1,1-Trichloroethane	µg/L	71-55-6	30	1 U	0.29 J	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	79-34-5	1	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	µg/L	79-00-5	3	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	76-13-1	20000	2 U	2 U	2 U	2 U	2 U	2 U
1,1-Dichloroethane	µg/L	75-34-3	50	1.1	1.7	2.4	2	2.7	2.2
1,1-Dichloroethene	µg/L	75-35-4	1	0.3 J	0.67 J	0.84 J	0.75 J	1.1	1 U
1,2,4-Trichlorobenzene	µg/L	120-82-1	9	2 U	2 U	2 U	0.21 J	2 U	2 U
1,2-Dibromo-3-chloropropane	µg/L	96-12-8	0.02	2 U	2 U	2 U	2 U	2 U	2 U
1,2-Dibromoethane	µg/L	106-93-4	0.03	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	µg/L	95-50-1	600	1 U	1 U	1 U	0.23 J	1 U	1 U
1,2-Dichloroethane	µg/L	107-06-2	2	0.28 J	0.54 J	0.54 J	1.3	1.2	0.76 J
1,2-Dichloropropane	µg/L	78-87-5	1	0.6 J	0.98 J	1.4	1.3	1.8	1.1
1,3-Dichlorobenzene	µg/L	541-73-1	600	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	µg/L	106-46-7	75	1 U	1 U	1 U	0.43 J	0.24 J	1 U
2-Hexanone	µg/L	591-78-6	300	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	µg/L	67-64-1	6000	4.4 J	38	5.7	5 U	41.8	12.3
Benzene	µg/L	71-43-2	1	1 U	1 U	1 U	0.26 J	1 U	0.26 J
Bromoform	µg/L	75-25-2	4	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	µg/L	74-83-9	10	1 U	1 U	1 U	1 U	1 U	1 U
Carbon disulfide	µg/L	75-15-0	700	1 U	1 U	1 U	1 U	1 U	1 U
Carbon tetrachloride	µg/L	56-23-5	1	1 U	1 U	1 U	0.52 J	0.7 J	1 U
Chlorobenzene	µg/L	108-90-7	50	0.24 J	0.38 J	0.29 J	1.4	0.97 J	1.1
Chloroethane	µg/L	75-00-3	5	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	µg/L	67-66-3	70	0.26 J	0.49 J	0.4 J	1.1	1.6	0.59 J
cis-1,2-Dichloroethene	µg/L	156-59-2	70	3.2	5.5	7.9	6.7	10.3	7.7
Dibromochloromethane	µg/L	124-48-1	1	1 U	1 U	1 U	1 U	1 U	1 U
Dichlorodifluoromethane	µg/L	75-71-8	1000	2 U	2 U	2 U	2 U	2 U	2 U
Ethylbenzene	µg/L	100-41-4	700	1 U	1 U	1 U	1 U	1 U	1 U
Isopropylbenzene	µg/L	98-82-8	700	1 U	1 U	1 U	1 U	1 U	1 U
Methyl acetate	µg/L	79-20-9	7000	5 U	5 U	5 U	5 U	5 U	5 U
Methyl ethyl ketone (2-Butanone)	µg/L	78-93-3	300	5 U	5 U	5 U	5 U	5 U	5 U
Methyl tert butyl ether	µg/L	1634-04-4	70	6.9	1.3	2.1	14.5	2.2	3.8
Methylene chloride	µg/L	75-09-2	3	1 U	1 U	1 U	0.25 J	1 U	1 U
Styrene	µg/L	100-42-5	100	2 U	2 U	2 U	2 U	2 U	2 U
Tetrachloroethene	µg/L	127-18-4	1	0.61 J	1	1	3.5	4.9	1.1
Toluene	µg/L	108-88-3	600	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	156-60-5	100	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	79-01-6	1	1.4	2.4	3.7	4.2	7.5	3.2
Trichlorofluoromethane	µg/L	75-69-4	2000	2 U	2 U	2 U	2 U	2 U	2 U
Vinyl Chloride	µg/L	75-01-4	1	1 U	1 U	1 U	1 U	1 U	0.49 J
Xylene (Total)	µg/L	1330-20-7	1000	1 U	1 U	1 U	1 U	1 U	1 U

**Notes:**

- Not analyzed

Concentrations which exceed the ROD Performance Standard are highlighted

blue

For some parameters the laboratory reporting limit exceeds the ROD Performance Standard. In cases where the laboratory reporting limit exceeds the ROD Performance Standard, and the parameter was not detected above the laboratory reporting limit, the value reported is the laboratory reporting limit and it is *italicized and brown*

J - Estimated value

U - Not detected above the laboratory reporting limit

**Table 5: Deep Aquifer Analytical Data Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017) Annual MNA Report**

Geosyntec Consultants

Well ID	Units	CASNumber	ROD Performance Standards	GM-04D			GM-05D		
				10/26/2015	10/19/2016	11/6/2017	10/8/2015	10/18/2016	11/6/2017
FieldSampleID				GM-4D.20151026	GM-04D.20161019	GM-04D.20171106	GM-5D.20151008	GM-05D.20161018	GM-05D.20171106
SampleMatrix				Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
VOCs									
1,1,1-Trichloroethane	µg/L	71-55-6	30	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	µg/L	79-34-5	1	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	µg/L	79-00-5	3	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	76-13-1	20000	2 U	2 U	2 U	2 U	2 U	2 U
1,1-Dichloroethane	µg/L	75-34-3	50	4.1	4.2	5.1	3	4.8	8.9
1,1-Dichloroethene	µg/L	75-35-4	1	0.56 J	0.64 J	0.85 J	0.63 J	1.2	2.5
1,2,4-Trichlorobenzene	µg/L	120-82-1	9	0.51 J	2 U	2 U	2 U	2 U	2 U
1,2-Dibromo-3-chloropropane	µg/L	96-12-8	0.02	2 U	2 U	2 U	2 U	2 U	2 U
1,2-Dibromoethane	µg/L	106-93-4	0.03	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	µg/L	95-50-1	600	0.36 J	0.25 J	0.23 J	1 U	1 U	1 U
1,2-Dichloroethane	µg/L	107-06-2	2	0.68 J	0.72 J	1.1	0.61 J	0.87 J	1.3
1,2-Dichloropropane	µg/L	78-87-5	1	2	2.1	2.3	2.2	3.9	6
1,3-Dichlorobenzene	µg/L	541-73-1	600	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	µg/L	106-46-7	75	0.47 J	0.23 J	1 U	1 U	1 U	1 U
2-Hexanone	µg/L	591-78-6	300	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	µg/L	67-64-1	6000	5 U	36.4	7.7	5 U	5 U	7.7
Benzene	µg/L	71-43-2	1	0.23 J	0.22 J	0.38 J	1 U	1 U	1 U
Bromoform	µg/L	75-25-2	4	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	µg/L	74-83-9	10	1 U	1 U	1 U	1 U	1 U	1 U
Carbon disulfide	µg/L	75-15-0	700	0.31 J	1 U	1 U	1 U	1 U	1 U
Carbon tetrachloride	µg/L	56-23-5	1	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	µg/L	108-90-7	50	1.4	1.2	1.7	0.35 J	0.35 J	1 U
Chloroethane	µg/L	75-00-3	5	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	µg/L	67-66-3	70	0.45 J	0.53 J	0.78 J	1 U	0.51 J	0.6 J
cis-1,2-Dichloroethene	µg/L	156-59-2	70	12.9	13.5	18.1	9.6	14	28.3
Dibromochloromethane	µg/L	124-48-1	1	1 U	1 U	1 U	1 U	1 U	1 U
Dichlorodifluoromethane	µg/L	75-71-8	1000	2 U	2 U	2 U	2 U	2 U	2 U
Ethylbenzene	µg/L	100-41-4	700	1 U	1 U	1 U	1 U	1 U	1 U
Isopropylbenzene	µg/L	98-82-8	700	1 U	1 U	1 U	1 U	1 U	1 U
Methyl acetate	µg/L	79-20-9	7000	5 U	5 U	5 U	5 U	5 U	5 U
Methyl ethyl ketone (2-Butanone)	µg/L	78-93-3	300	5 U	5 U	5 U	5 U	5 U	5 U
Methyl tert butyl ether	µg/L	1634-04-4	70	64.4	6.6	8.3	43.1	5.4	8
Methylene chloride	µg/L	75-09-2	3	1 U	1 U	1 U	1 U	1 U	1 U
Styrene	µg/L	100-42-5	100	2 U	2 U	2 U	2 U	2 U	2 U
Tetrachloroethene	µg/L	127-18-4	1	1.8	1.2	1.1	0.79 J	1.5	2.1
Toluene	µg/L	108-88-3	600	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	156-60-5	100	1 U	1 U	1 U	0.78 J	1.3	3.6
Trichloroethene	µg/L	79-01-6	1	4.1	5	5.4	4.7	6.7	9.7
Trichlorofluoromethane	µg/L	75-69-4	2000	2 U	2 U	2 U	2 U	2 U	2 U
Vinyl Chloride	µg/L	75-01-4	1	0.6 J	0.73 J	1.2	0.57 J	0.4 J	0.4 J
Xylene (Total)	µg/L	1330-20-7	1000	1 U	1 U	1 U	1 U	1 U	1 U

**Notes:**

- Not analyzed

Concentrations which exceed the ROD Performance Standard are highlighted

blue

For some parameters the laboratory reporting limit exceeds the ROD Performance Standard. In cases where the laboratory reporting limit exceeds the ROD Performance Standard, and the parameter was not detected above the laboratory reporting limit, the value reported is the laboratory reporting limit and it is *italicized and brown*

J - Estimated value

U - Not detected above the laboratory reporting limit

**Table 5: Deep Aquifer Analytical Data Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017) Annual MNA Report**

Geosyntec Consultants

Well ID	Units	CASNumber	ROD Performance Standards	GM-06D			GM-07D		
				10/8/2015	10/18/2016	11/6/2017	10/7/2015	10/20/2016	11/6/2017
FieldSampleID			GM-6D.20151008	GM-06D.20161018	GM-06D.20171106	GM-7D.20151007	GM-07D.20161020	GM-07D.20171106	
SampleMatrix			Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
<b>VOCs</b>									
1,1,1-Trichloroethane	µg/L	71-55-6	30	0.92 J	0.85 J	0.65 J	0.23 J	0.25 J	1 U
1,1,2,2-Tetrachloroethane	µg/L	79-34-5	1	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	µg/L	79-00-5	3	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	76-13-1	20000	2 U	2 U	2 U	2 U	2 U	2 U
1,1-Dichloroethane	µg/L	75-34-3	50	4	3.7	3.5	2.3	2.3	2.1
1,1-Dichloroethene	µg/L	75-35-4	1	1.3	1.3	1.4	0.65 J	0.75 J	0.82 J
1,2,4-Trichlorobenzene	µg/L	120-82-1	9	2 U	2 U	2 U	0.27 J	2 U	2 U
1,2-Dibromo-3-chloropropane	µg/L	96-12-8	0.02	2 U	2 U	2 U	2 U	2 U	2 U
1,2-Dibromoethane	µg/L	106-93-4	0.03	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	µg/L	95-50-1	600	1 U	1 U	1 U	0.54 J	0.41 J	0.38 J
1,2-Dichloroethane	µg/L	107-06-2	2	0.66 J	0.42 J	1 U	1.4	1.5	1.6
1,2-Dichloropropane	µg/L	78-87-5	1	2.9	2.4	2.3	1.2	1.4	1.4
1,3-Dichlorobenzene	µg/L	541-73-1	600	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlorobenzene	µg/L	106-46-7	75	1 U	1 U	1 U	0.89 J	0.73 J	0.51 J
2-Hexanone	µg/L	591-78-6	300	5 U	5 U	5 U	5 U	5 U	5 U
Acetone	µg/L	67-64-1	6000	5 U	55.1	16	5 U	17.8	11.9
Benzene	µg/L	71-43-2	1	1 U	1 U	1 U	0.33 J	0.4 J	0.52 J
Bromoform	µg/L	75-25-2	4	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	µg/L	74-83-9	10	1 U	1 U	1 U	1 U	1 U	1 U
Carbon disulfide	µg/L	75-15-0	700	1 U	1 U	1 U	1 U	1 U	1 U
Carbon tetrachloride	µg/L	56-23-5	1	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	µg/L	108-90-7	50	1 U	1 U	1 U	2.1	2.3	2.5
Chloroethane	µg/L	75-00-3	5	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	µg/L	67-66-3	70	1.5	1.3	1.3	0.95 J	1.1	1.2
cis-1,2-Dichloroethene	µg/L	156-59-2	70	14	12.6	13.4	9	9.2	9.2
Dibromochloromethane	µg/L	124-48-1	1	1 U	1 U	1 U	1 U	1 U	1 U
Dichlorodifluoromethane	µg/L	75-71-8	1000	2 U	2 U	2 U	2 U	2 U	2 U
Ethylbenzene	µg/L	100-41-4	700	1 U	1 U	1 U	1 U	1 U	1 U
Isopropylbenzene	µg/L	98-82-8	700	1 U	1 U	1 U	1 U	1 U	1 U
Methyl acetate	µg/L	79-20-9	7000	5 U	5 U	5 U	5 U	5 U	5 U
Methyl ethyl ketone (2-Butanone)	µg/L	78-93-3	300	5 U	5 U	5 U	5 U	5 U	5 U
Methyl tert butyl ether	µg/L	1634-04-4	70	35.1	3.4	2.7	11.6	1.6	1.1
Methylene chloride	µg/L	75-09-2	3	1 U	1 U	1 U	0.33 J	1 U	1 U
Styrene	µg/L	100-42-5	100	2 U	2 U	2 U	2 U	2 U	2 U
Tetrachloroethene	µg/L	127-18-4	1	7.5	4.7	2.5	2.1	1.3	0.9 J
Toluene	µg/L	108-88-3	600	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	156-60-5	100	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	µg/L	79-01-6	1	9.9	8.6	7.5	12	10.7	6.9
Trichlorofluoromethane	µg/L	75-69-4	2000	2 U	2 U	2 U	2 U	2 U	2 U
Vinyl Chloride	µg/L	75-01-4	1	1 U	1 U	1 U	0.23 J	1 U	0.32 J
Xylene (Total)	µg/L	1330-20-7	1000	1 U	1 U	1 U	1 U	1 U	1 U

**Notes:**

- Not analyzed

Concentrations which exceed the ROD Performance Standard are highlighted

blue

For some parameters the laboratory reporting limit exceeds the ROD Performance Standard. In cases where the laboratory reporting limit exceeds the ROD Performance Standard, and the parameter was not detected above the laboratory reporting limit, the value reported is the laboratory reporting limit and it is *italicized and brown*

J - Estimated value

U - Not detected above the laboratory reporting limit

**Table 5: Deep Aquifer Analytical Data Summary  
Swope Oil and Chemical Company Superfund Site  
Year 3 (2017) Annual MNA Report**

Geosyntec Consultants

Well ID	Units	CASNumber	ROD Performance Standards	GM-08D		
				10/8/2015	10/20/2016	11/6/2017
FieldSampleID			GM-8D.20151008	GM-8D.20161020	GM-8D.20171106	
SampleMatrix			Groundwater	Groundwater	Groundwater	
<b>VOCs</b>						
1,1,1-Trichloroethane	µg/L	71-55-6	30	0.22 J	0.46 J	1 U
1,1,2,2-Tetrachloroethane	µg/L	79-34-5	1	1 U	1 U	1 U
1,1,2-Trichloroethane	µg/L	79-00-5	3	1 U	1 U	1 U
1,1,2-Trichlorotrifluoroethane (Freon 113)	µg/L	76-13-1	20000	2 U	2 U	2 U
1,1-Dichloroethane	µg/L	75-34-3	50	6.4	8.7	7.2
1,1-Dichloroethene	µg/L	75-35-4	1	0.57 J	0.97 J	0.77 J
1,2,4-Trichlorobenzene	µg/L	120-82-1	9	2 U	2 U	2 U
1,2-Dibromo-3-chloropropane	µg/L	96-12-8	0.02	2 U	2 U	2 U
1,2-Dibromoethane	µg/L	106-93-4	0.03	1 U	1 U	1 U
1,2-Dichlorobenzene	µg/L	95-50-1	600	0.46 J	0.27 J	1 U
1,2-Dichloroethane	µg/L	107-06-2	2	4.2	6	5
1,2-Dichloropropane	µg/L	78-87-5	1	0.77 J	0.4 J	0.55 J
1,3-Dichlorobenzene	µg/L	541-73-1	600	1 U	1 U	1 U
1,4-Dichlorobenzene	µg/L	106-46-7	75	1.1	0.69 J	0.37 J
2-Hexanone	µg/L	591-78-6	300	5 U	5 U	5 U
Acetone	µg/L	67-64-1	6000	4.2 J	35.4	5.4
Benzene	µg/L	71-43-2	1	0.41 J	0.41 J	1 U
Bromoform	µg/L	75-25-2	4	1 U	1 U	1 U
Bromomethane	µg/L	74-83-9	10	1 U	1 U	1 U
Carbon disulfide	µg/L	75-15-0	700	1 U	1 U	1 U
Carbon tetrachloride	µg/L	56-23-5	1	1 U	1 U	1 U
Chlorobenzene	µg/L	108-90-7	50	1.8	1.5	1.4
Chloroethane	µg/L	75-00-3	5	1 U	1 U	1 U
Chloroform	µg/L	67-66-3	70	0.43 J	0.28 J	1 U
cis-1,2-Dichloroethene	µg/L	156-59-2	70	17.5	29.5	28.2
Dibromochloromethane	µg/L	124-48-1	1	1 U	1 U	1 U
Dichlorodifluoromethane	µg/L	75-71-8	1000	2 U	2 U	2 U
Ethylbenzene	µg/L	100-41-4	700	1 U	1 U	1 U
Isopropylbenzene	µg/L	98-82-8	700	1 U	1 U	1 U
Methyl acetate	µg/L	79-20-9	7000	5 U	5 U	5 U
Methyl ethyl ketone (2-Butanone)	µg/L	78-93-3	300	5 U	5 U	5 U
Methyl tert butyl ether	µg/L	1634-04-4	70	3.5	0.31 J	0.31 J
Methylene chloride	µg/L	75-09-2	3	0.63 J	1 U	1 U
Styrene	µg/L	100-42-5	100	2 U	2 U	2 U
Tetrachloroethene	µg/L	127-18-4	1	4.3	2.9	1.5
Toluene	µg/L	108-88-3	600	1 U	1 U	1 U
trans-1,2-Dichloroethene	µg/L	156-60-5	100	1 U	0.23 J	1 U
Trichloroethene	µg/L	79-01-6	1	9.8	19	25.4
Trichlorofluoromethane	µg/L	75-69-4	2000	2 U	2 U	2 U
Vinyl Chloride	µg/L	75-01-4	1	1.3	2.3	1.5
Xylene (Total)	µg/L	1330-20-7	1000	1 U	1 U	1 U

**Notes:**

-- Not analyzed

Concentrations which exceed the ROD Performance Standard are highlighted blue

For some parameters the laboratory reporting limit exceeds the ROD Performance Standard. In cases where the laboratory reporting limit exceeds the ROD Performance Standard, and the parameter was not detected above the laboratory reporting limit, the value reported is the laboratory reporting limit and it is *italicized and brown*

J - Estimated value

U - Not detected above the laboratory reporting limit

**Table 6: Mann-Kendall Analysis Summary**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017) Annual MNA Report**

Geosyntec Consultants

Location	Location Relative to the Site	PCE	TCE	cDCE	VC	Ethene
GM-01S	On-Site	Increasing	Stable	No Trend	NA	NA
GM-02S	Off-Site upgradient	Increasing	Increasing	Increasing	Increasing	NA
GM-03RS	On-Site	No Trend	Increasing	Decreasing	No Trend	NA
GM-05S	Off-Site upgradient	Stable	Increasing	Probably Increasing	NA	NA
GM-06S	Off-Site downgradient/sidegradient	Increasing	Increasing	Increasing	NA	NA
GM-07S	Off-Site downgradient/sidegradient	Stable	Stable	Stable	NA	NA
GM-08S	Off-Site downgradient/sidegradient	NA	Increasing	Increasing	No Trend	Increasing
MW-01	On-Site	No Trend	Increasing	Increasing	NA	NA
MW-02	On-Site	Decreasing	Stable	Stable	NA	NA
MW-04	On-Site	No Trend	Probably Increasing	Increasing	NA	NA
MW-07	Off-Site downgradient/sidegradient	Stable	Decreasing	Decreasing	NA	NA
MW-09S	Off-Site downgradient/sidegradient	Stable	Stable	Decreasing	Probably Decreasing	Probably Decreasing
MW-10S	Off-Site upgradient	Stable	No Trend	No Trend	NA	No Trend
MW-11S	Off-Site downgradient/sidegradient	Decreasing	Decreasing	Decreasing	NA	NA

**Notes:**

The full post-Cap data set was used in this analysis (i.e., 2015, 2016, and 2017 data).

Concentration Trend = Indication of whether Mann-Kendall test can detect a trend, and if so, the direction of the trend is shown

NA = Not analyzed due to N<4 or <50% detection frequency

PCE- Tetrachloroethene

TCE- Trichloroethene

cDCE- cis-1,2-Dichloroethene

VC- Vinyl chloride

**Table 7: First Order Natural Attenuation Rates**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017) Annual MNA Report**

**Geosyntec Consultants**

Well Grouping	Well ID	TCE Attenuation Rate ( $\mu\text{g/L}$ per year)		cDCE Attenuation Rate ( $\mu\text{g/L}$ per year)	
		Pre-Cap	Post-Cap	Pre-Cap	Post-Cap
On-Site	GM-03RS	-0.05	-0.27	0.02	0.13
	MW-02	-0.11	0.15	0.08	0.21
	MW-04	-0.03	-0.08	0.26	-0.21
Off-Site Upgradient	GM-02S	-	-	-0.15	-0.48
	MW-10S	-0.56	-0.11	-0.68	-0.07
Off-Site Downgradient/Sidegradient	GM-07S	0.07	-0.24	-0.19	-0.02
	GM-08S	-	-	0.43	1.30
	MW-09S	0.10	0.13	0.15	0.36
	MW-11S	0.17	0.61	-	-

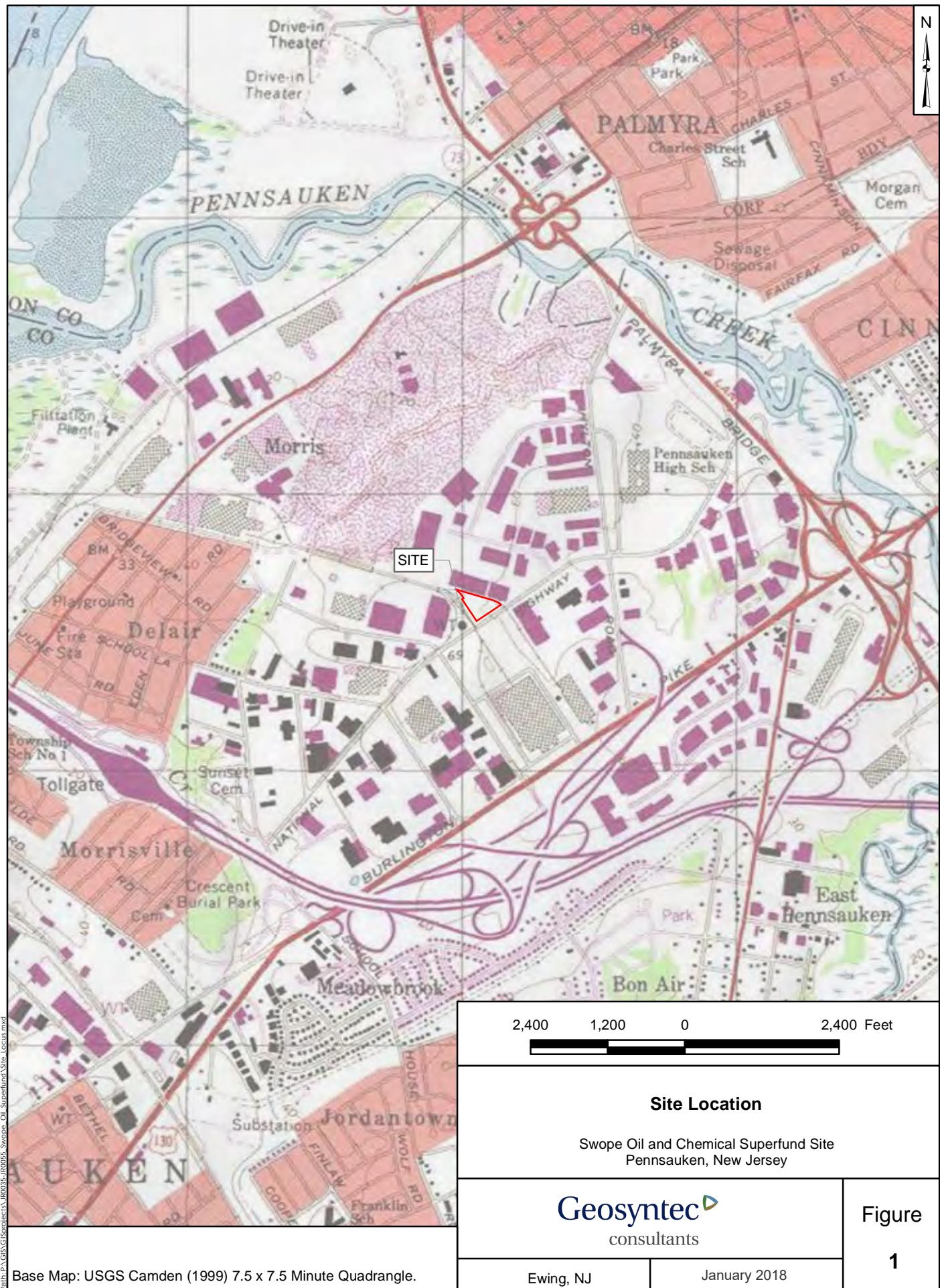
**Notes:**

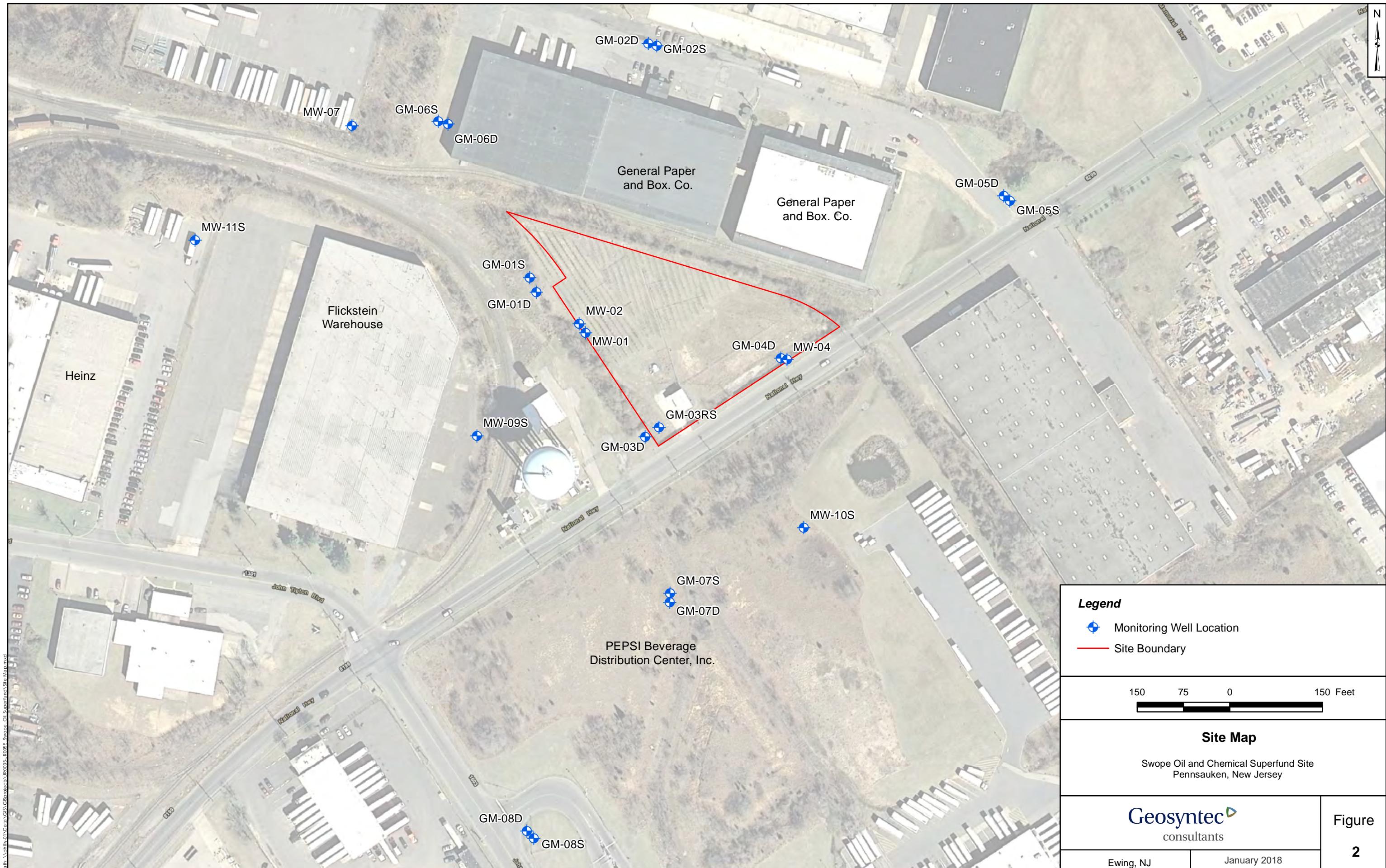
A positive degradation rate indicates attenuation.

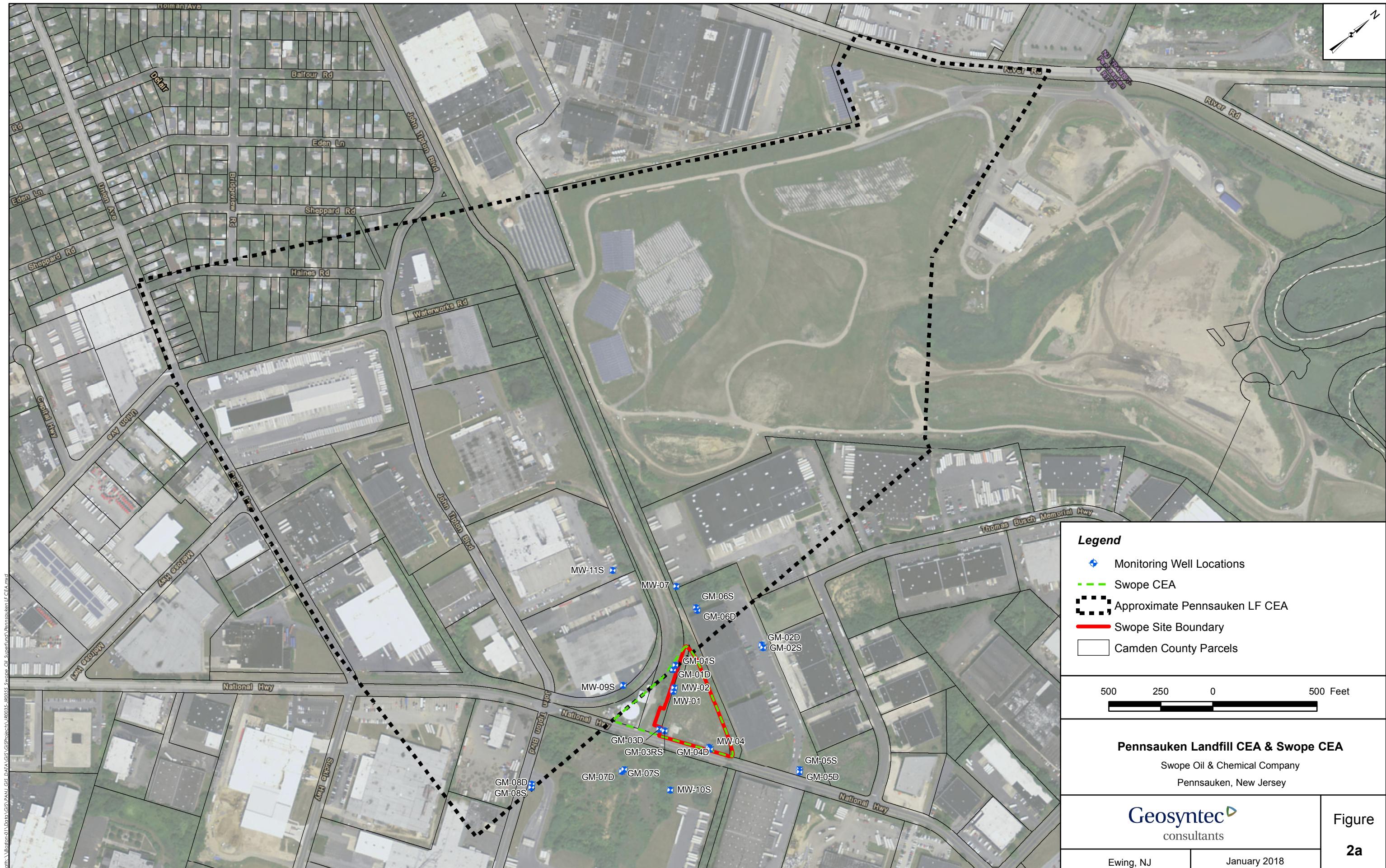
A negative degradation rate may indicate attenuation is not occurring, or there are too few data points to draw a conclusion.

- = Not analyzed

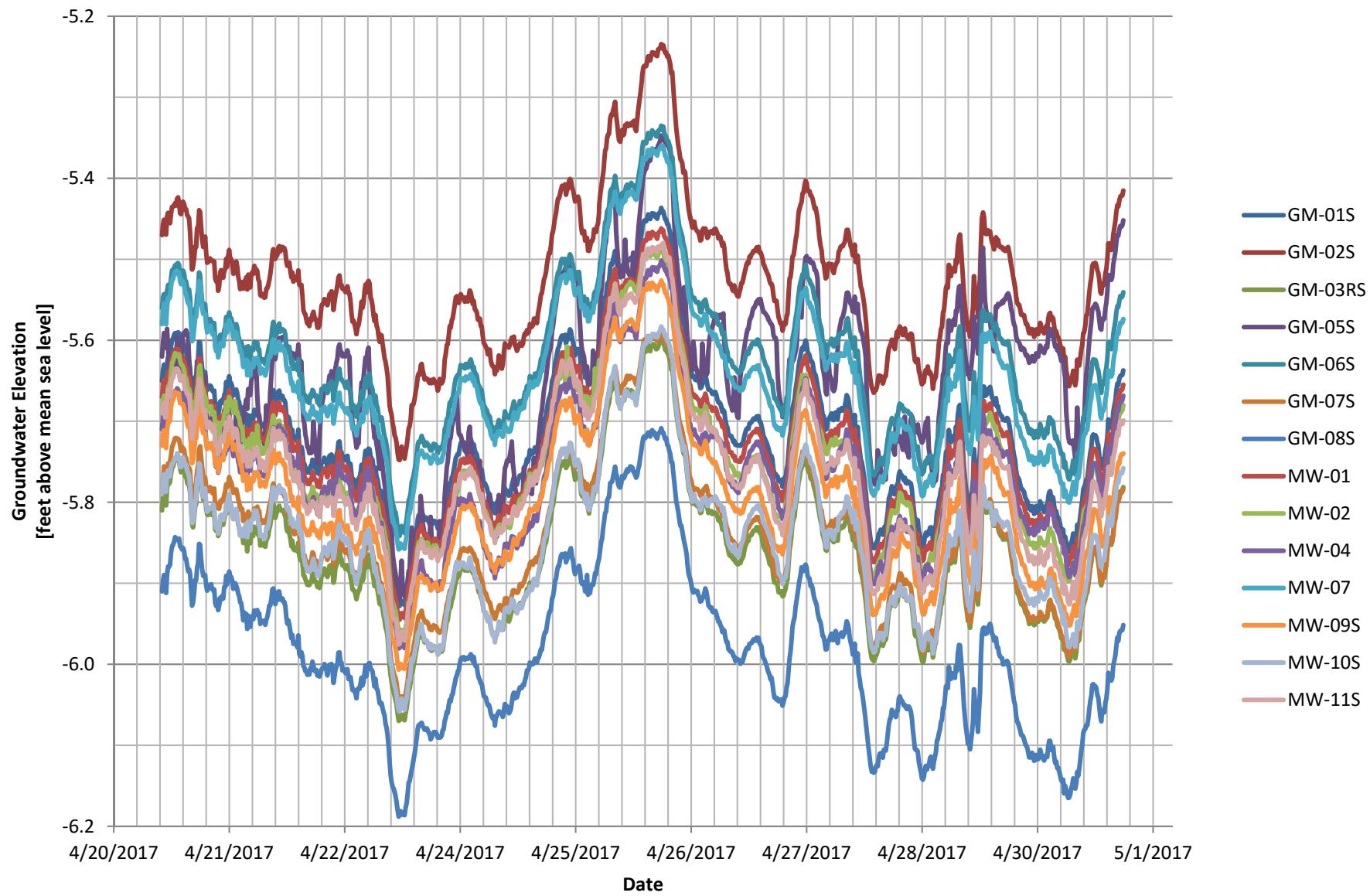
## **FIGURES**



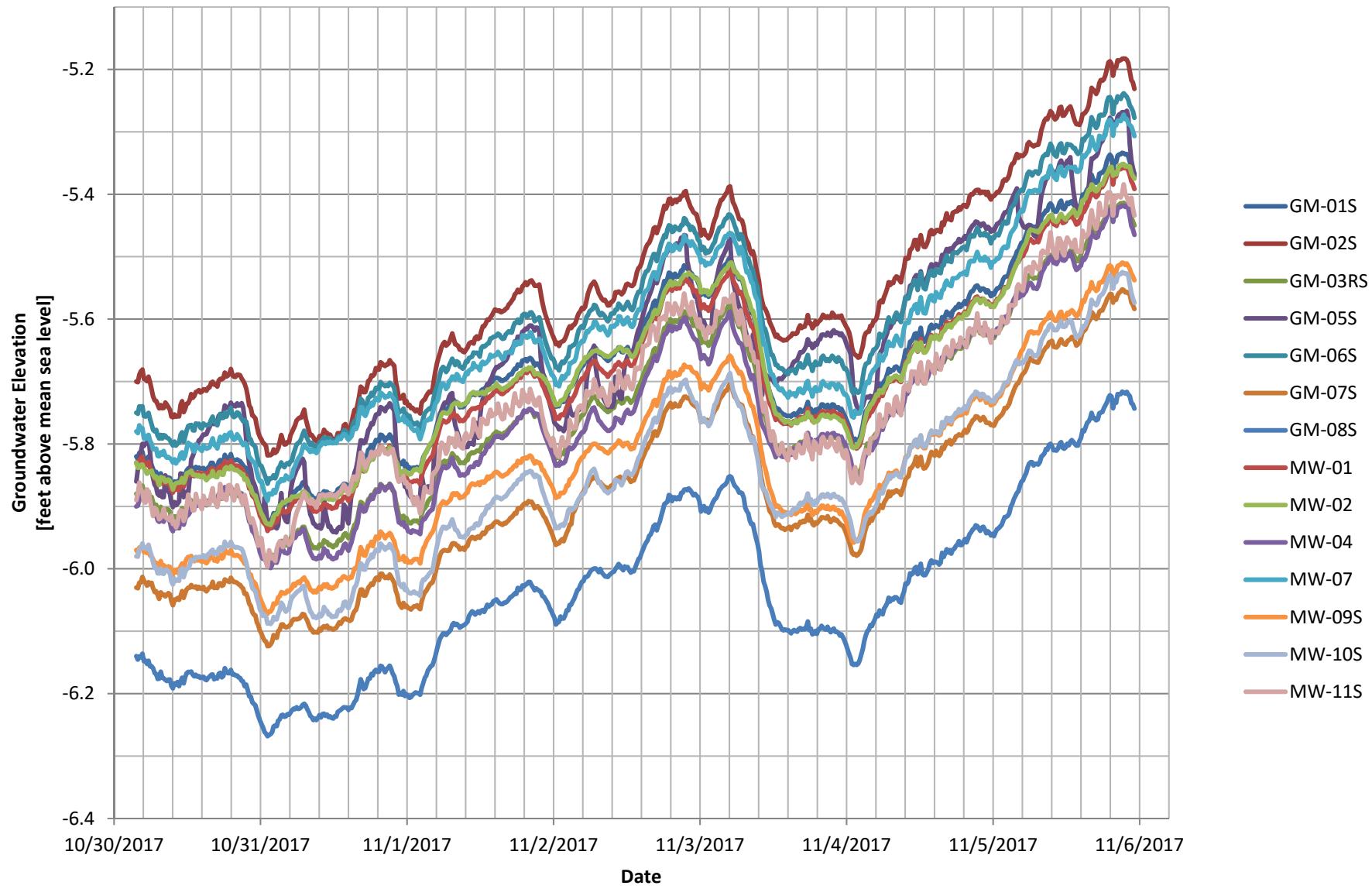


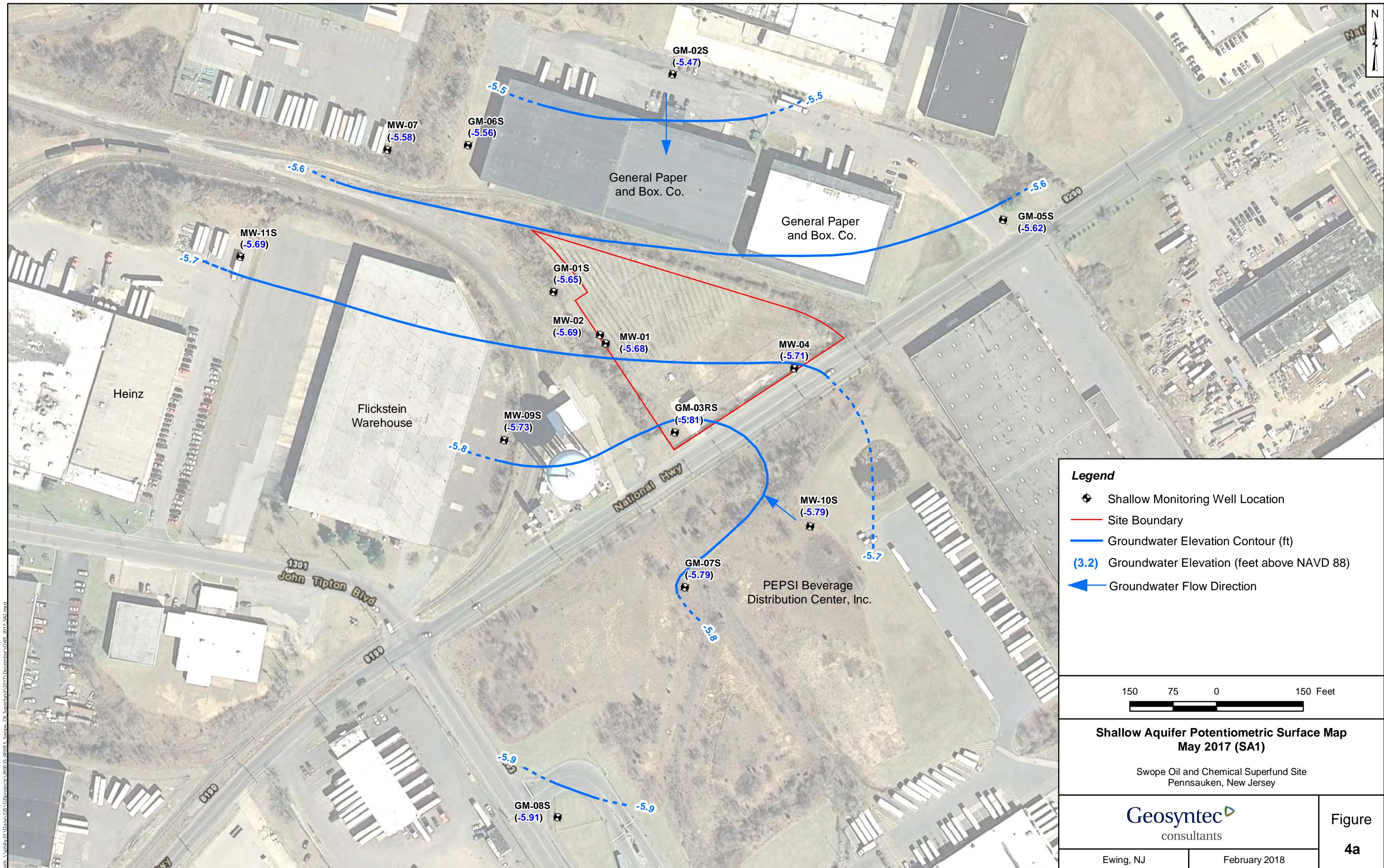


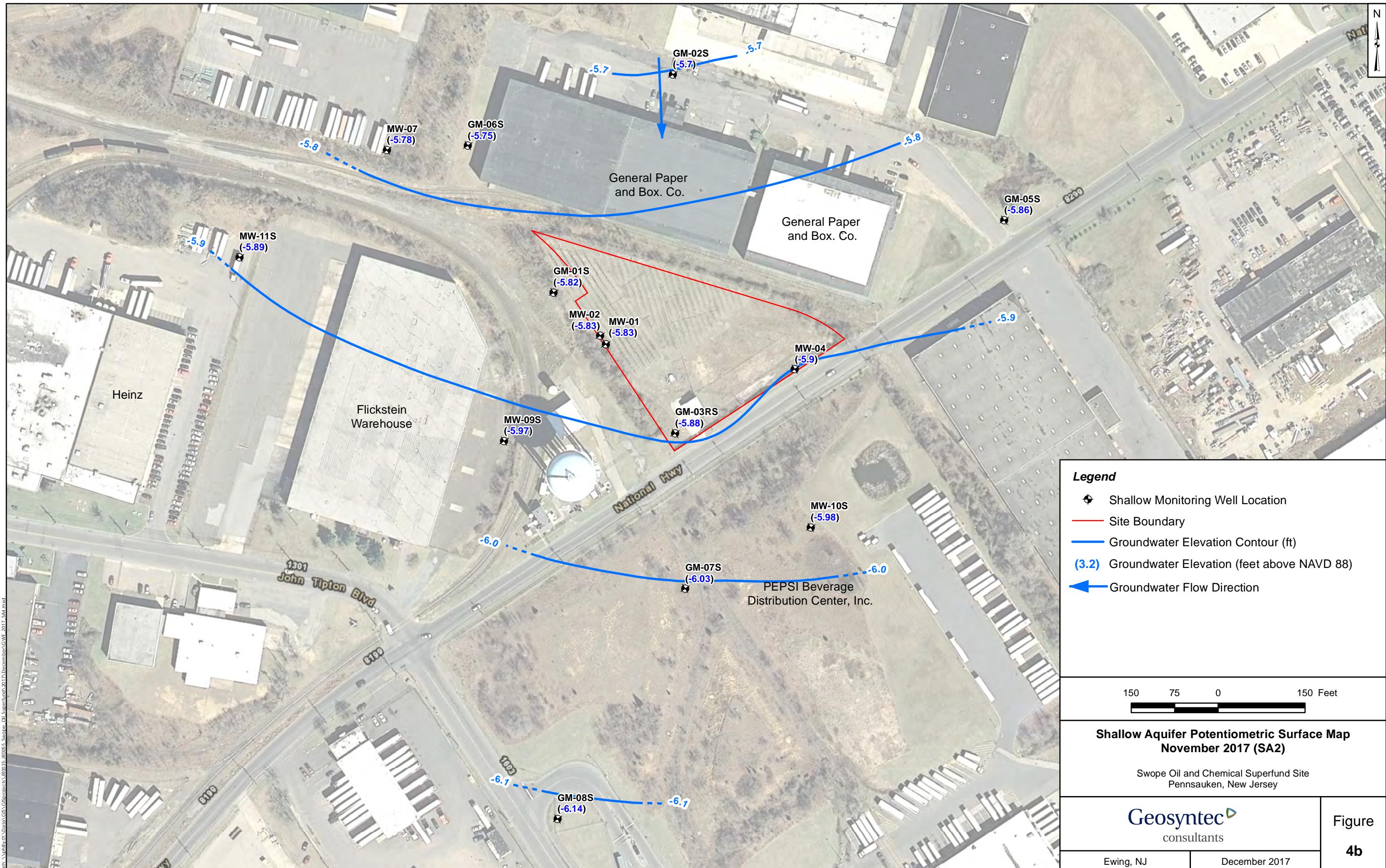
**Figure 3a**  
**Swope Oil and Chemical Company Superfund Site**  
**Continuous Groundwater Elevation Monitoring, SA1 2017**



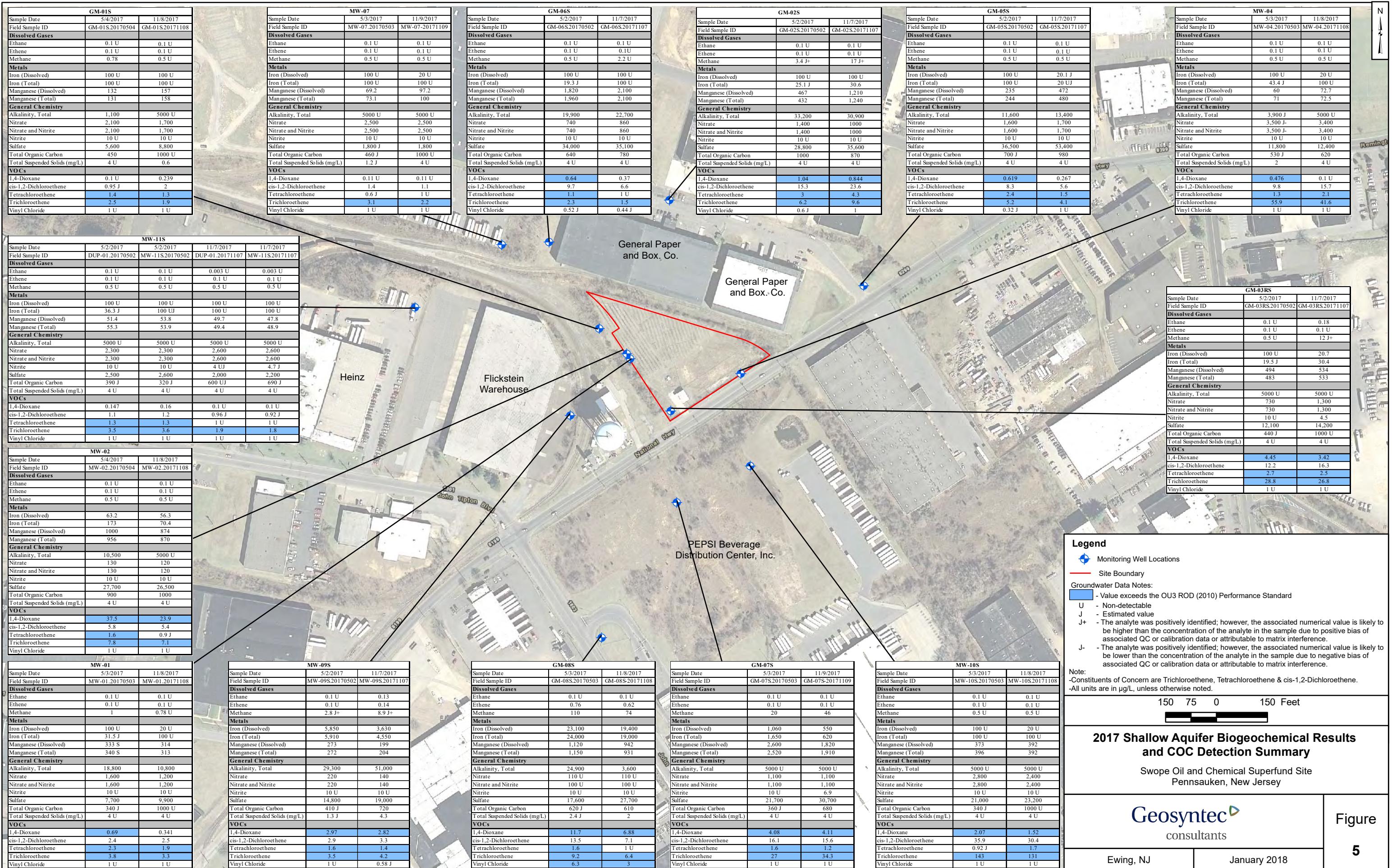
**Figure 3b**  
**Swope Oil and Chemical Company Superfund Site**  
**Continuous Groundwater Elevation Monitoring, SA2 2017**

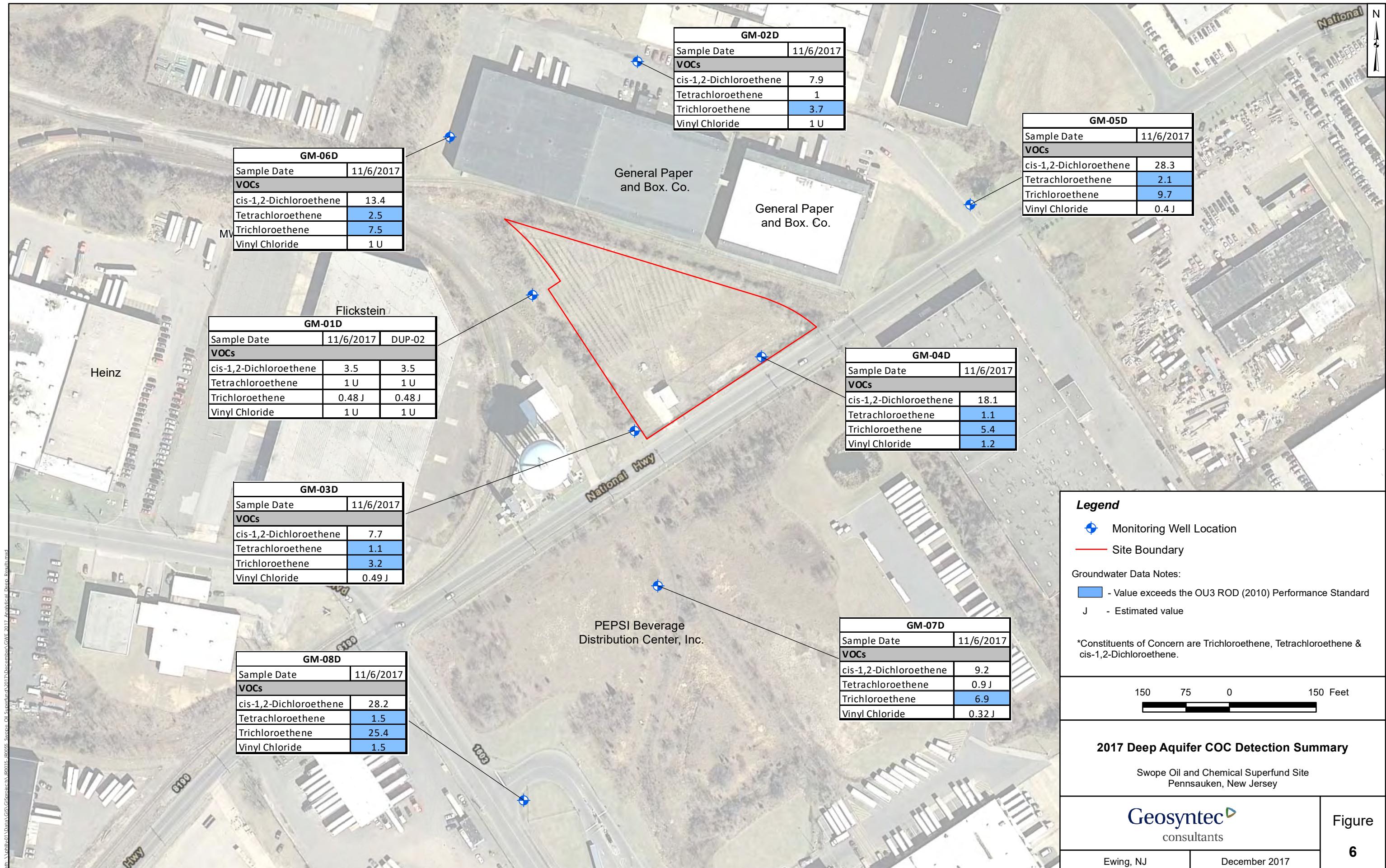


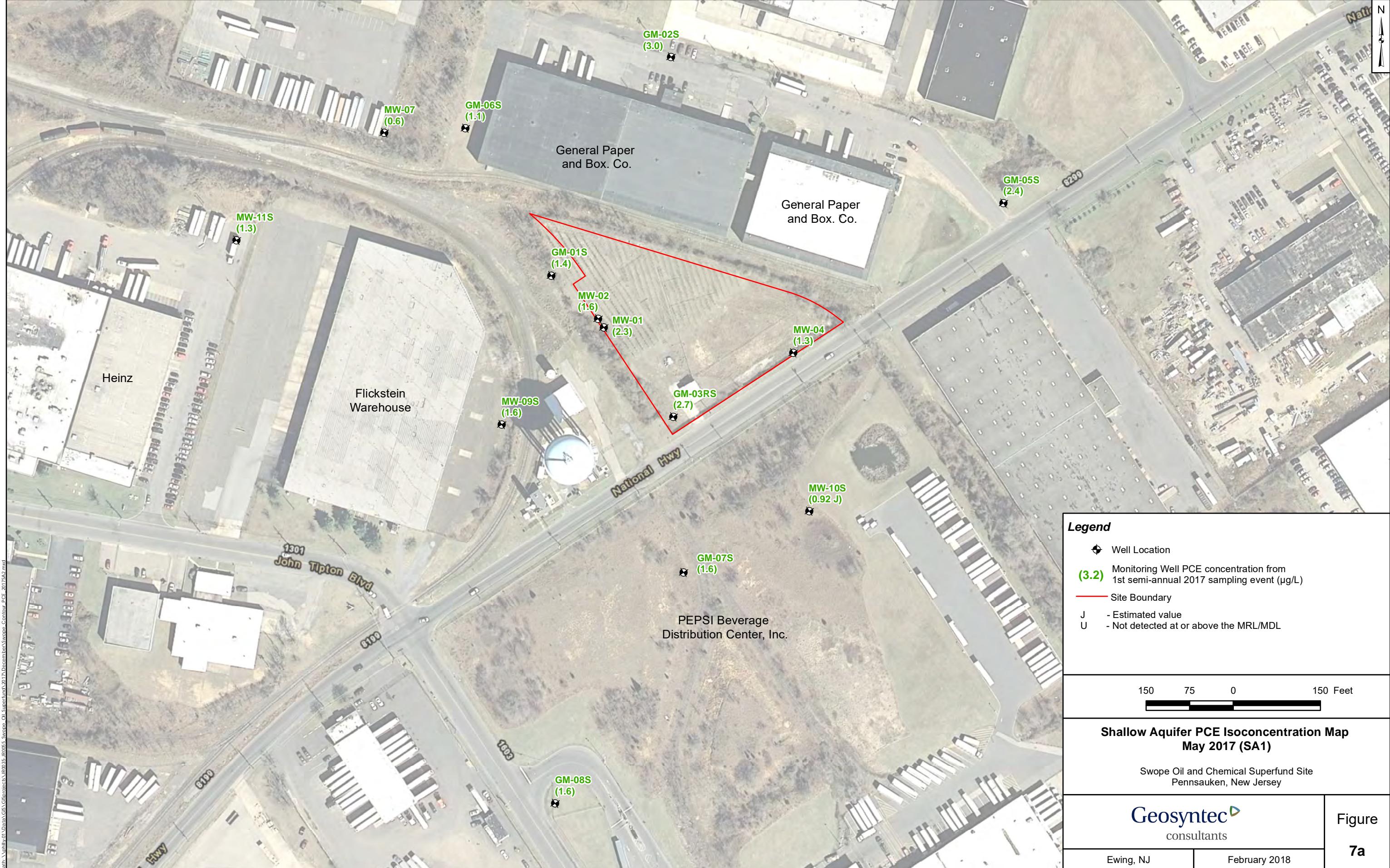


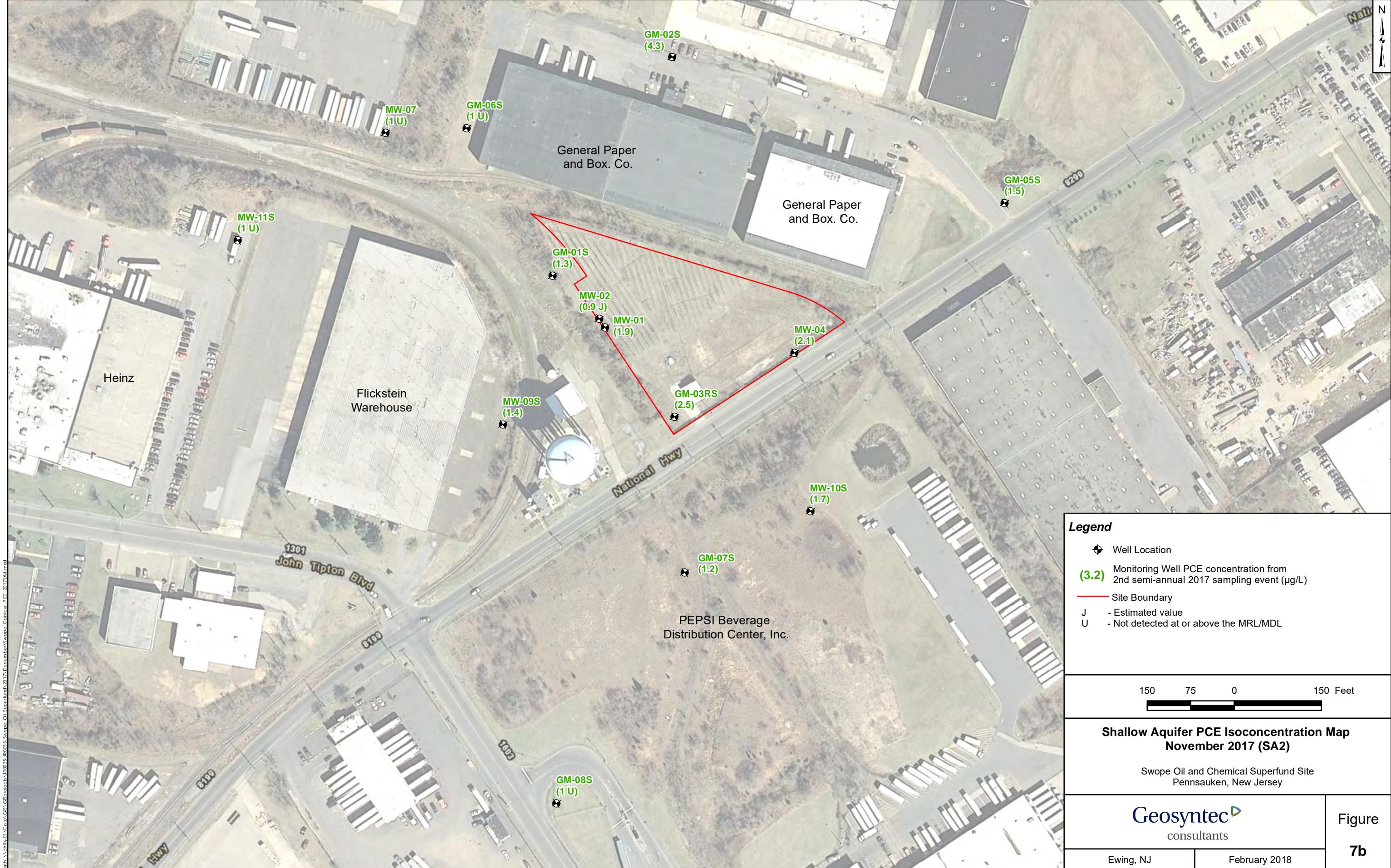


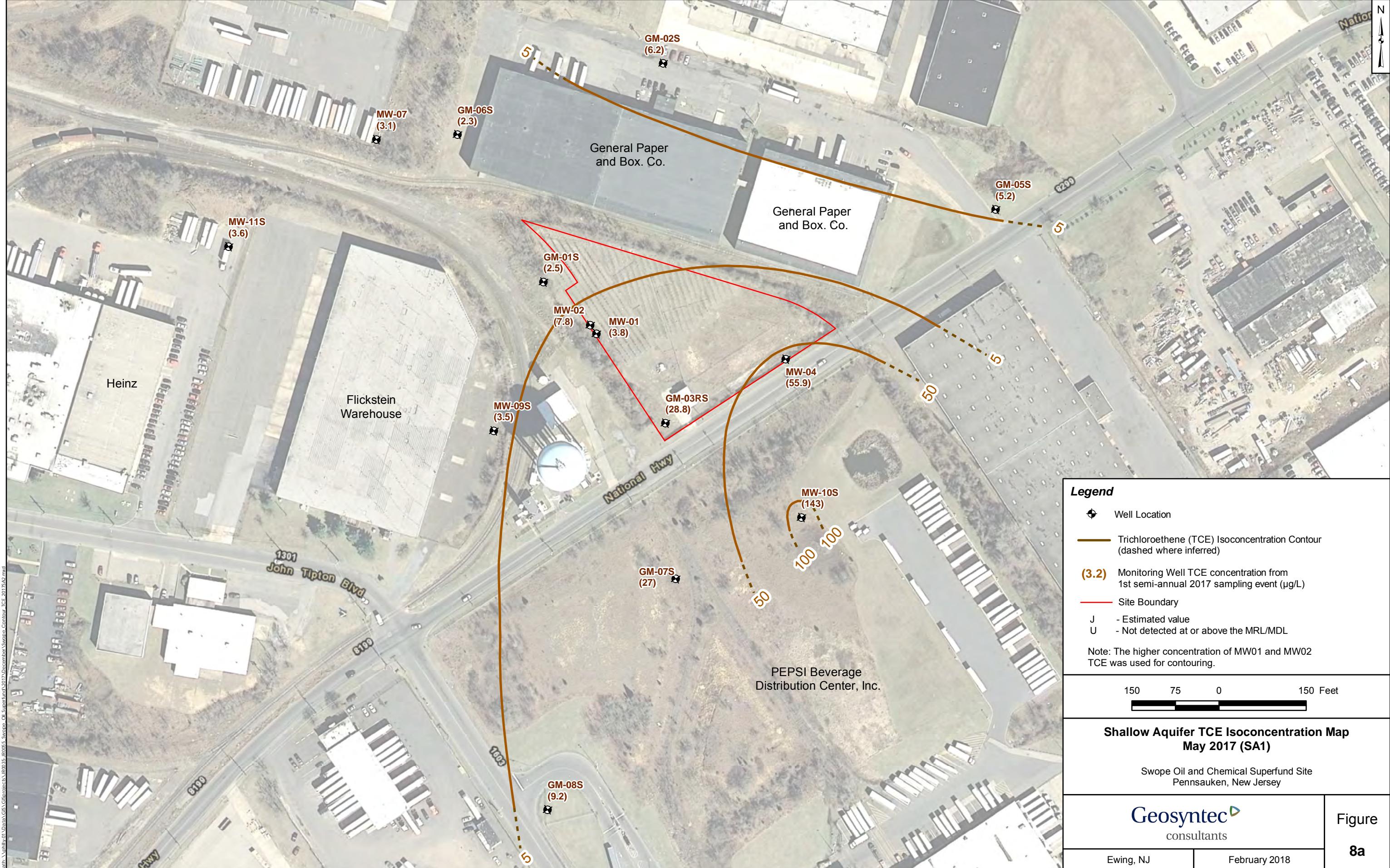
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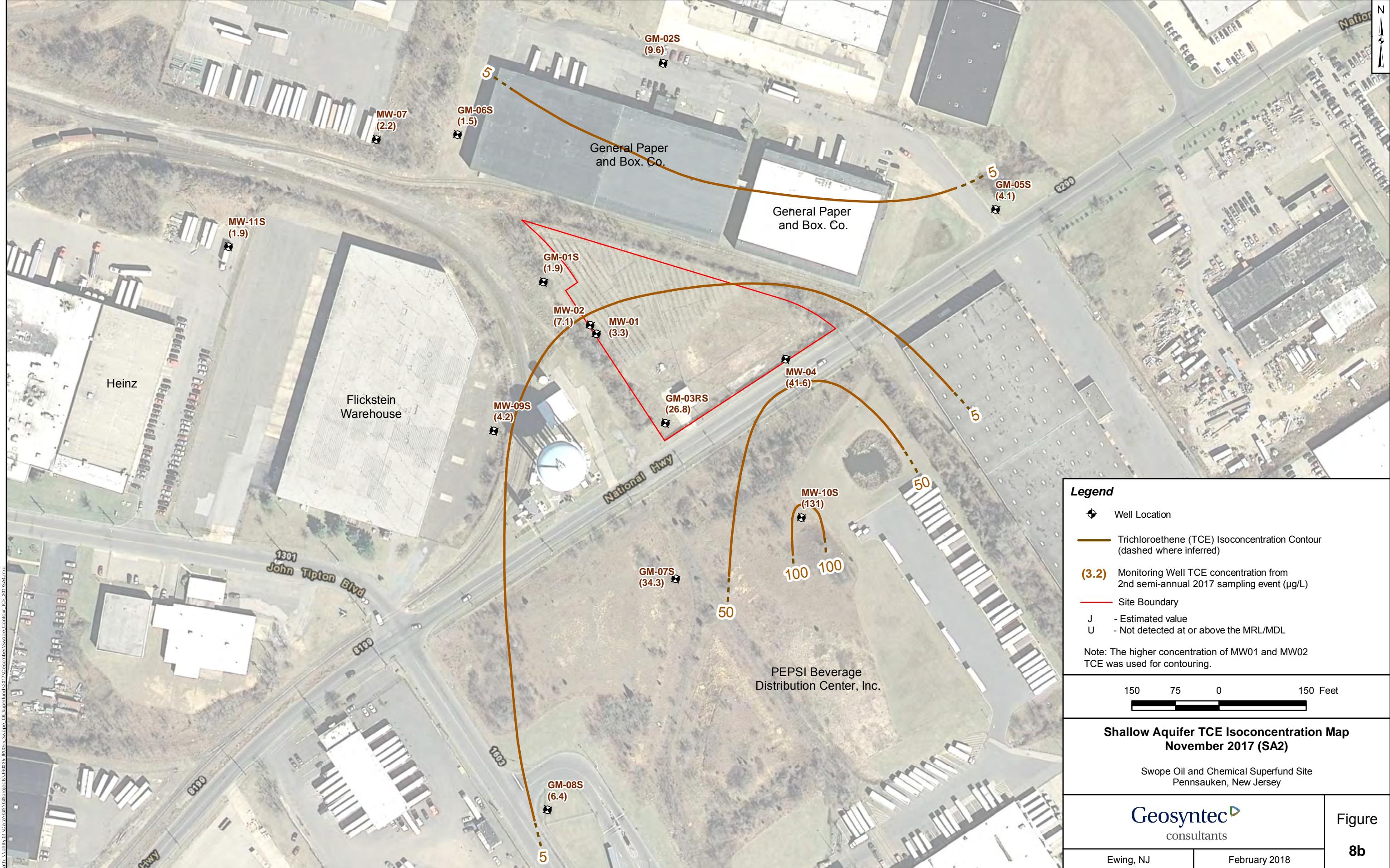


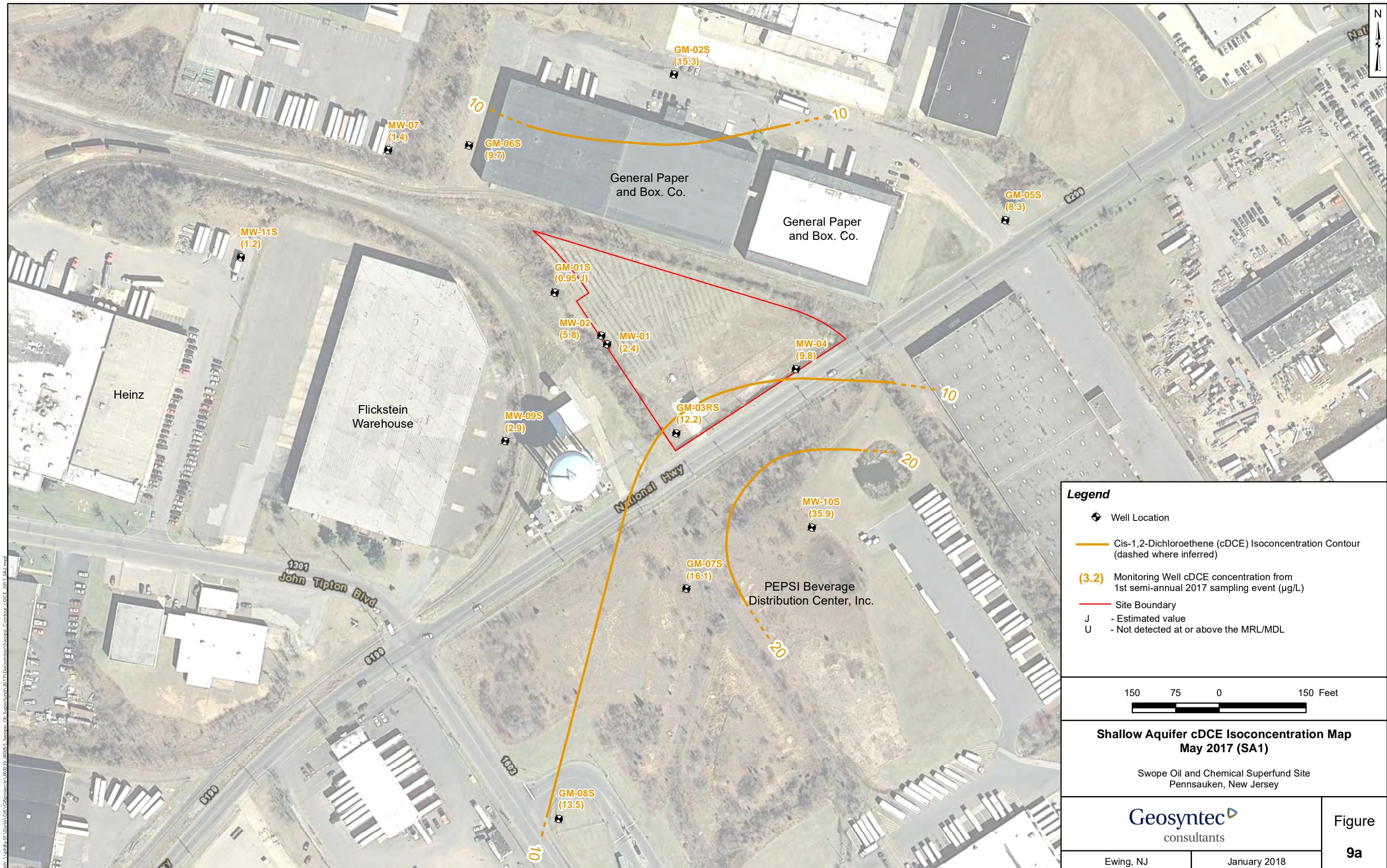


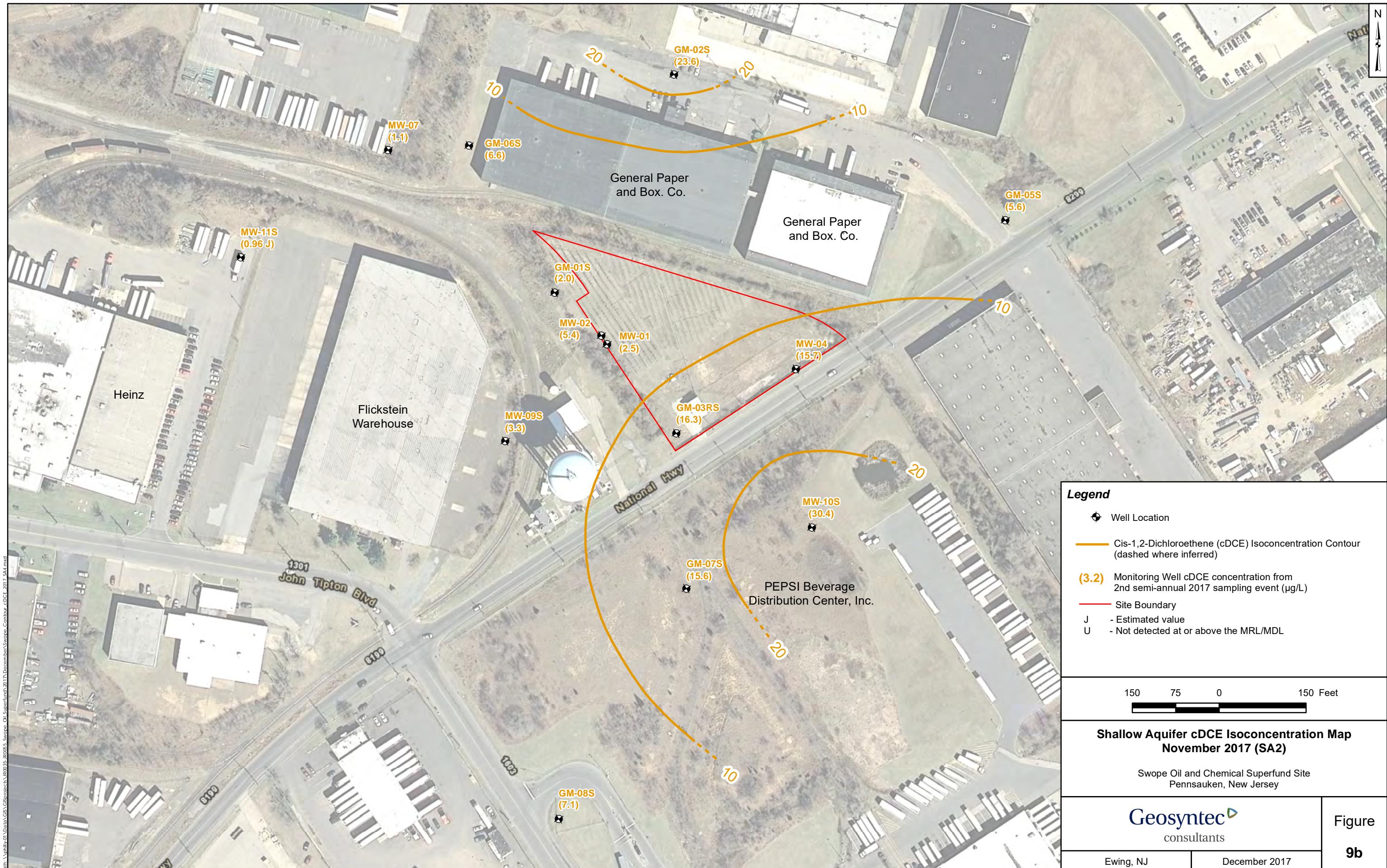


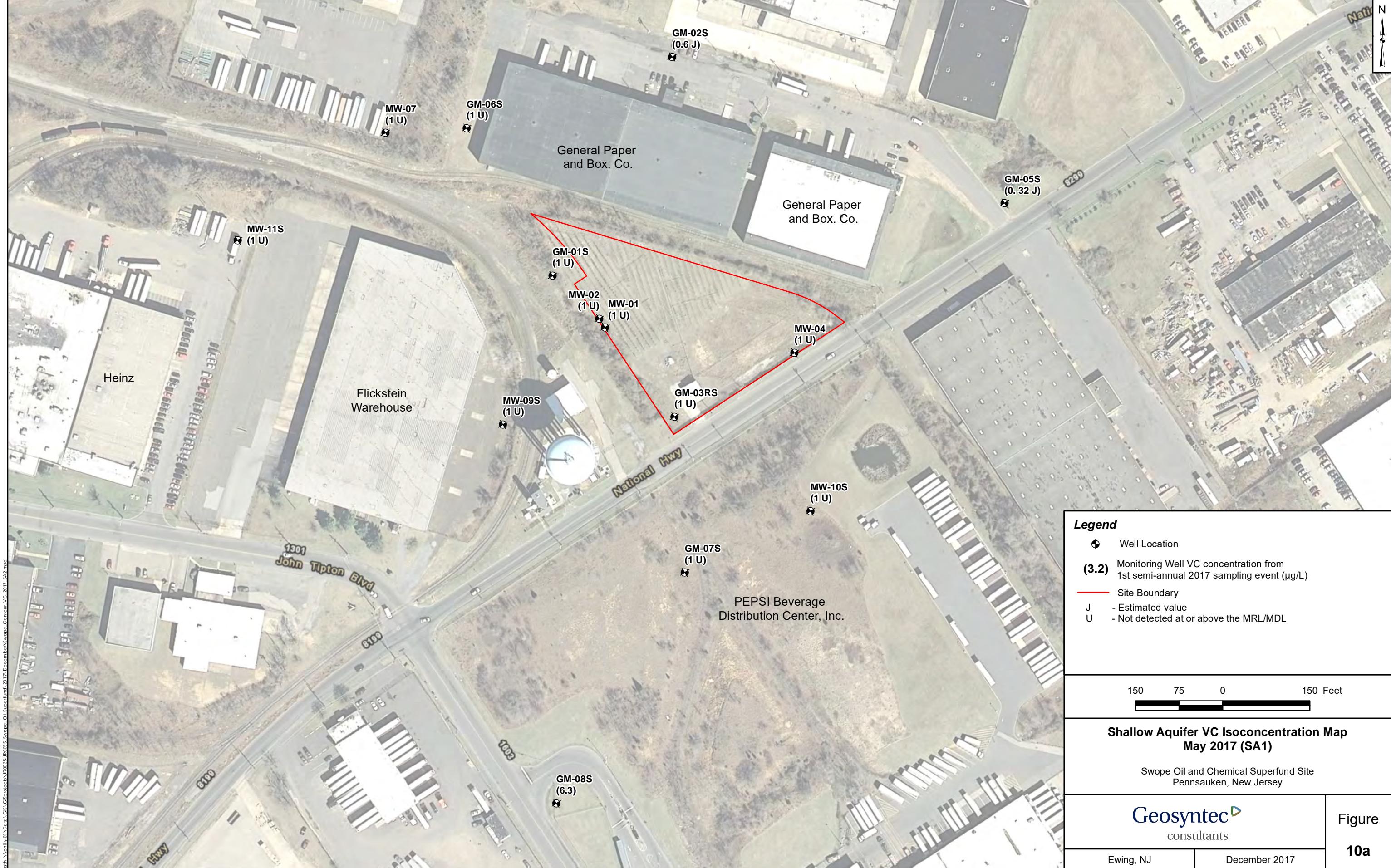












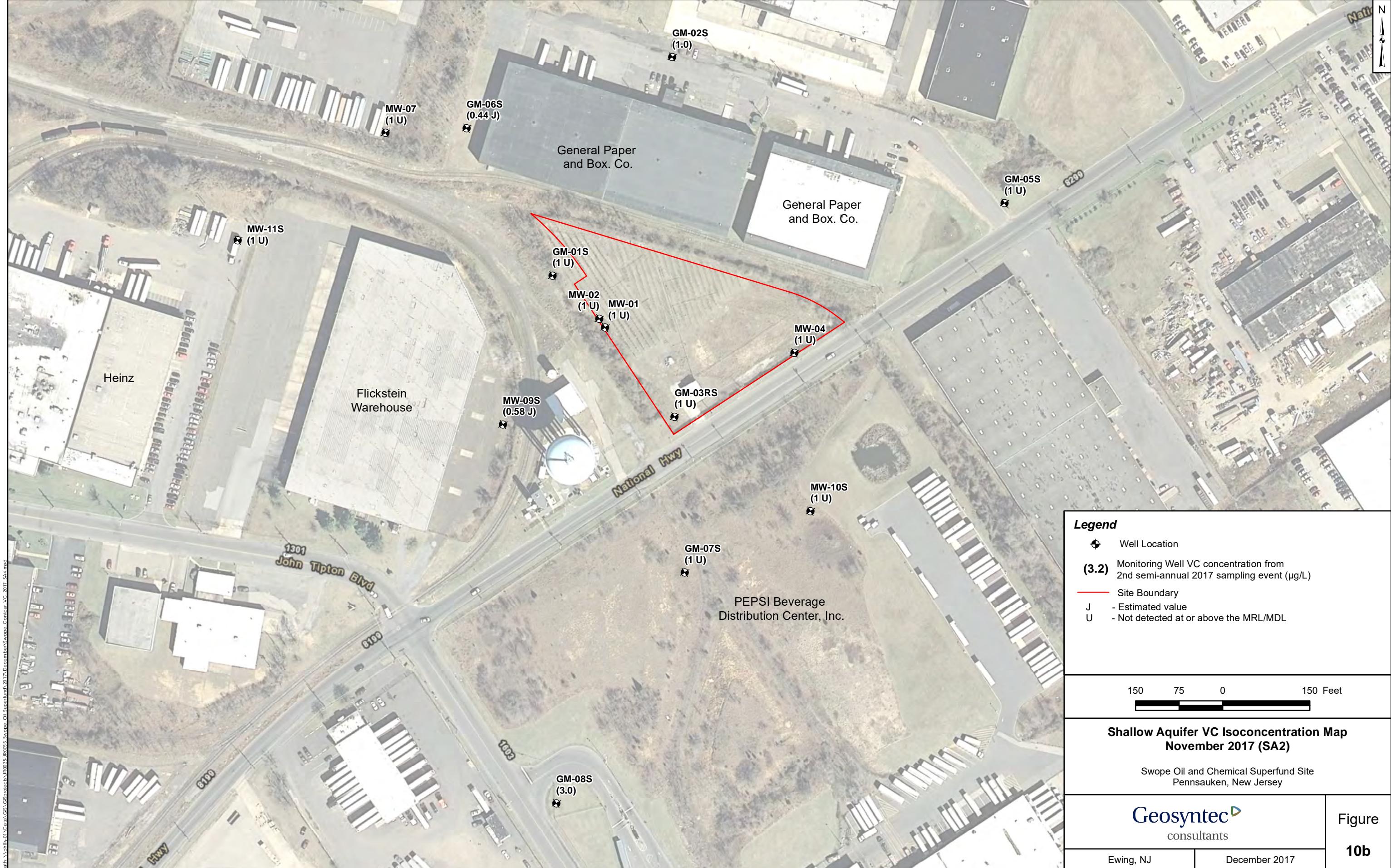


Figure 11a: Highest PCE Shallow Groundwater Concentration  
by Monitoring Well Hydraulic Position since 2012

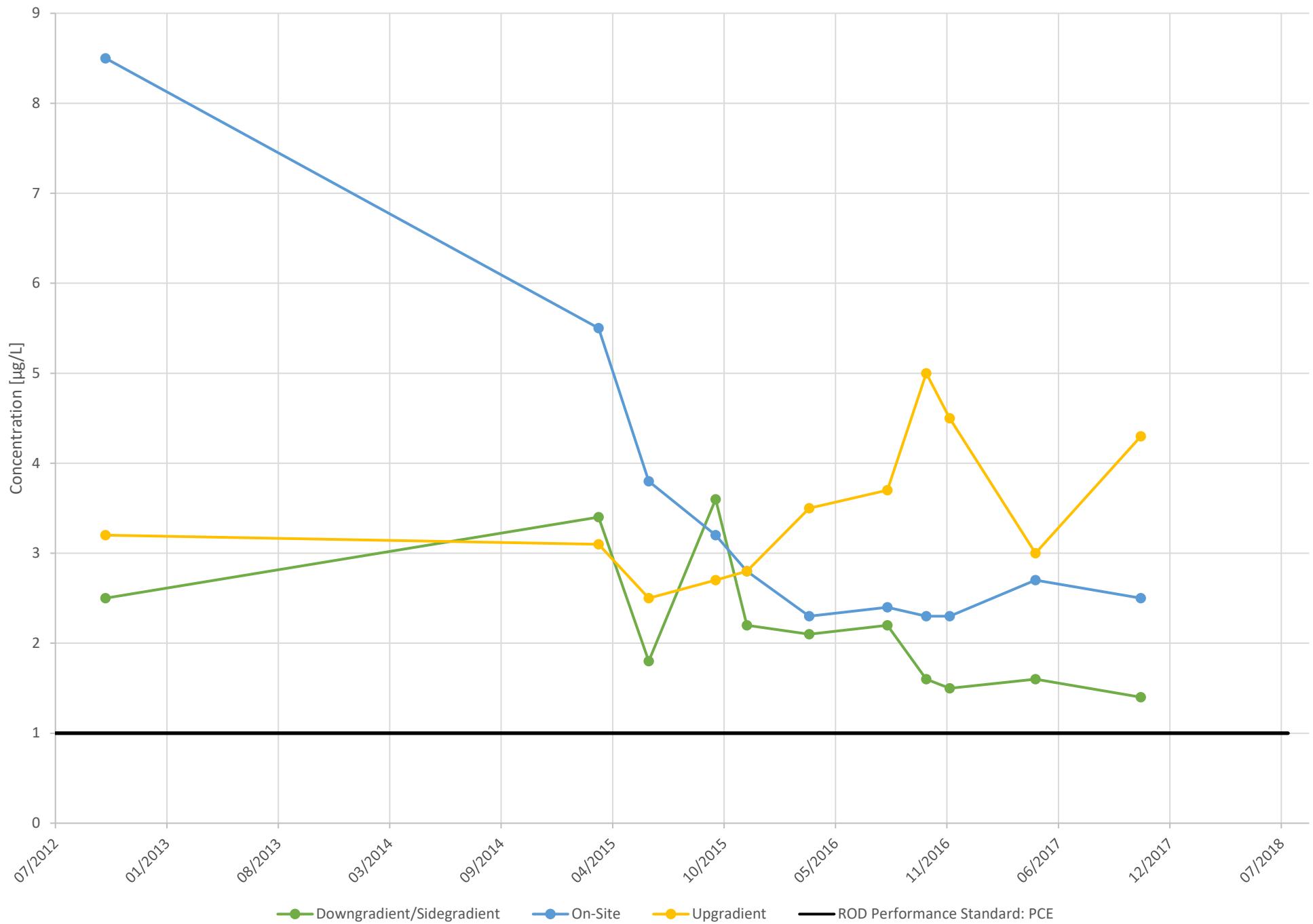


Figure 11b: Upgradient Monitoring Wells  
PCE Shallow Groundwater Concentrations since 2012

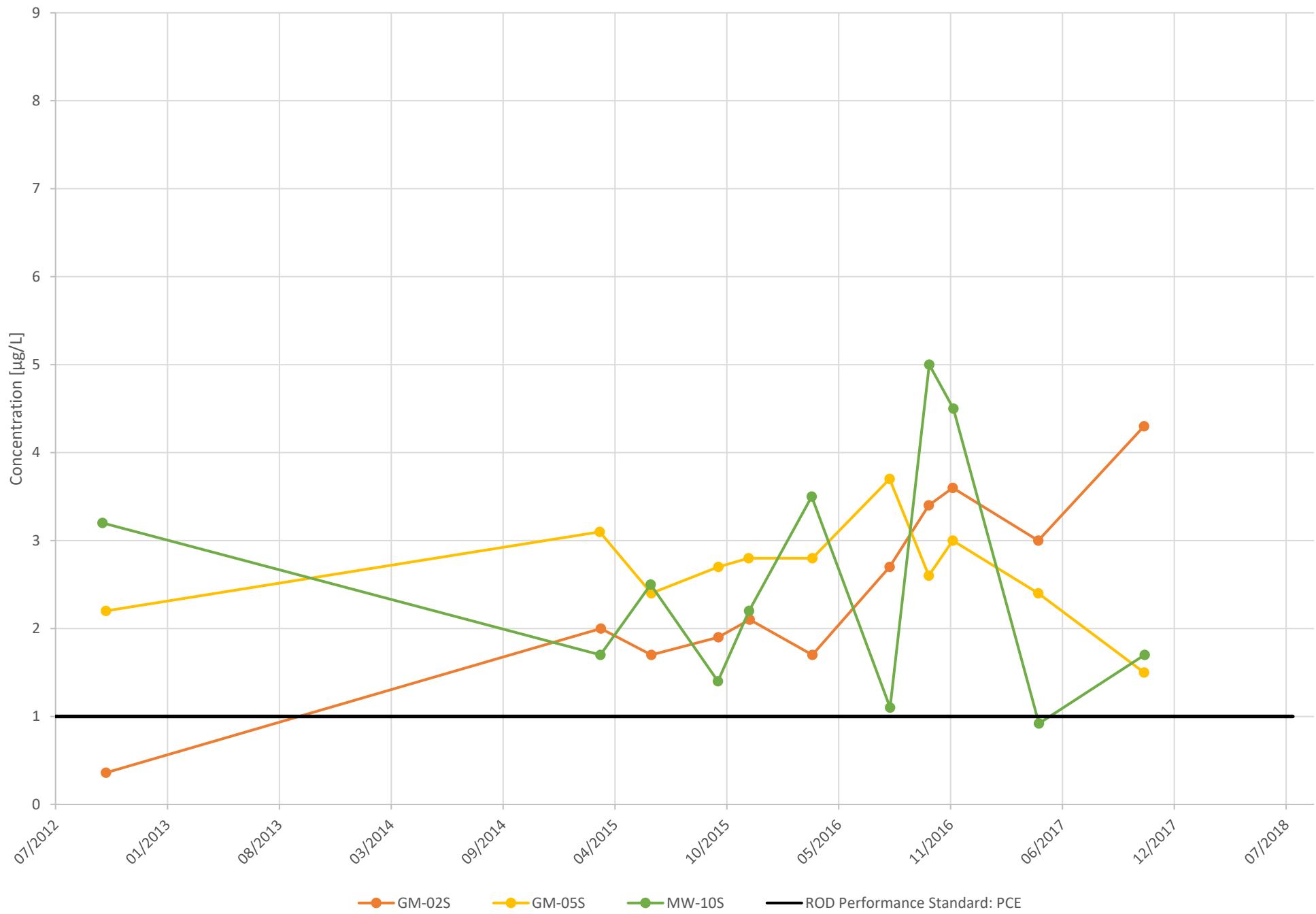


Figure 11c: On-Site Monitoring Wells  
PCE Shallow Groundwater Concentrations since 2012

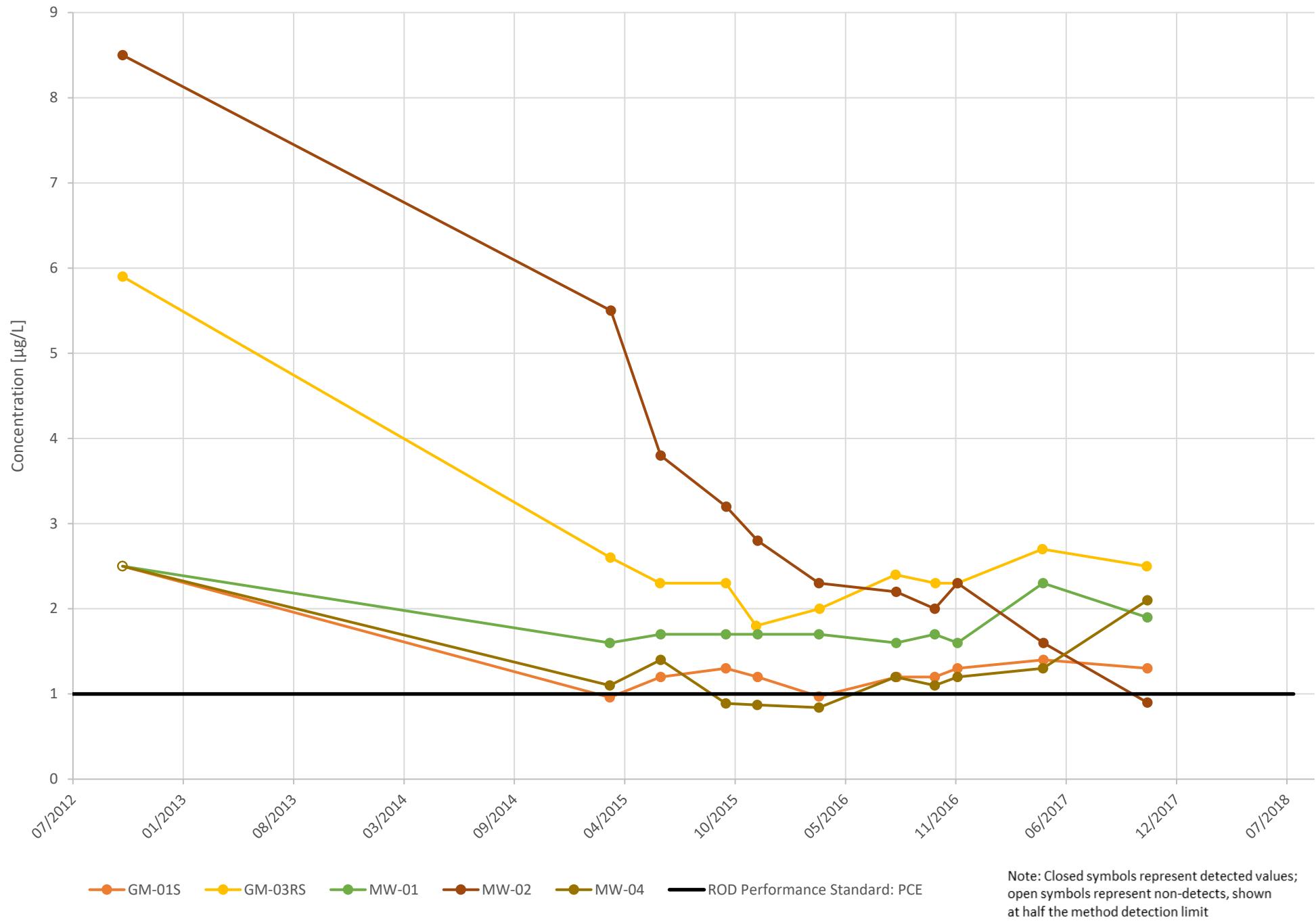


Figure 11d: Downgradient/Sidegradient Monitoring Wells  
PCE Shallow Groundwater Concentrations since 2012

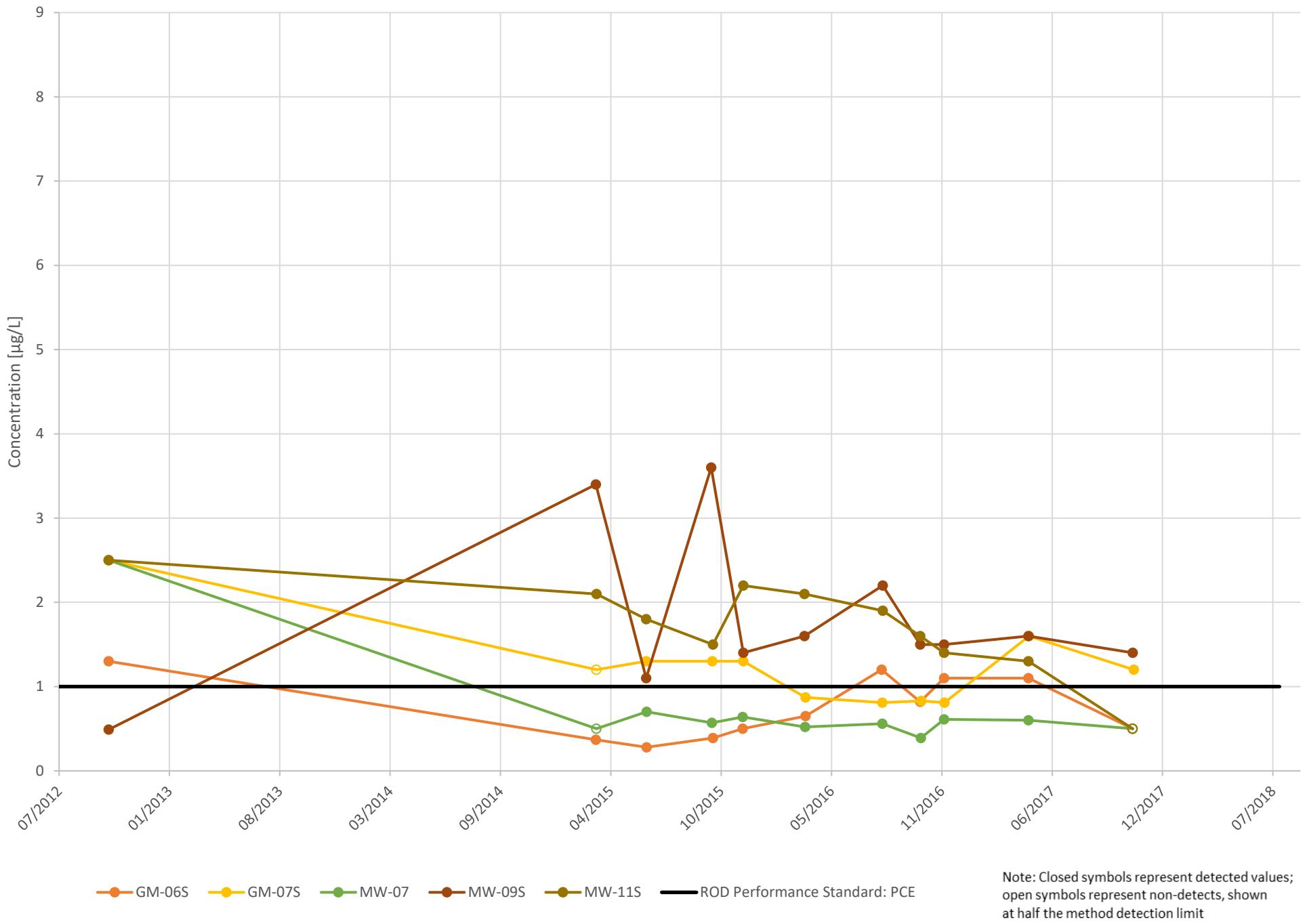


Figure 12a: Highest TCE Shallow Groundwater Concentration  
by Monitoring Well Hydraulic Position since 2012

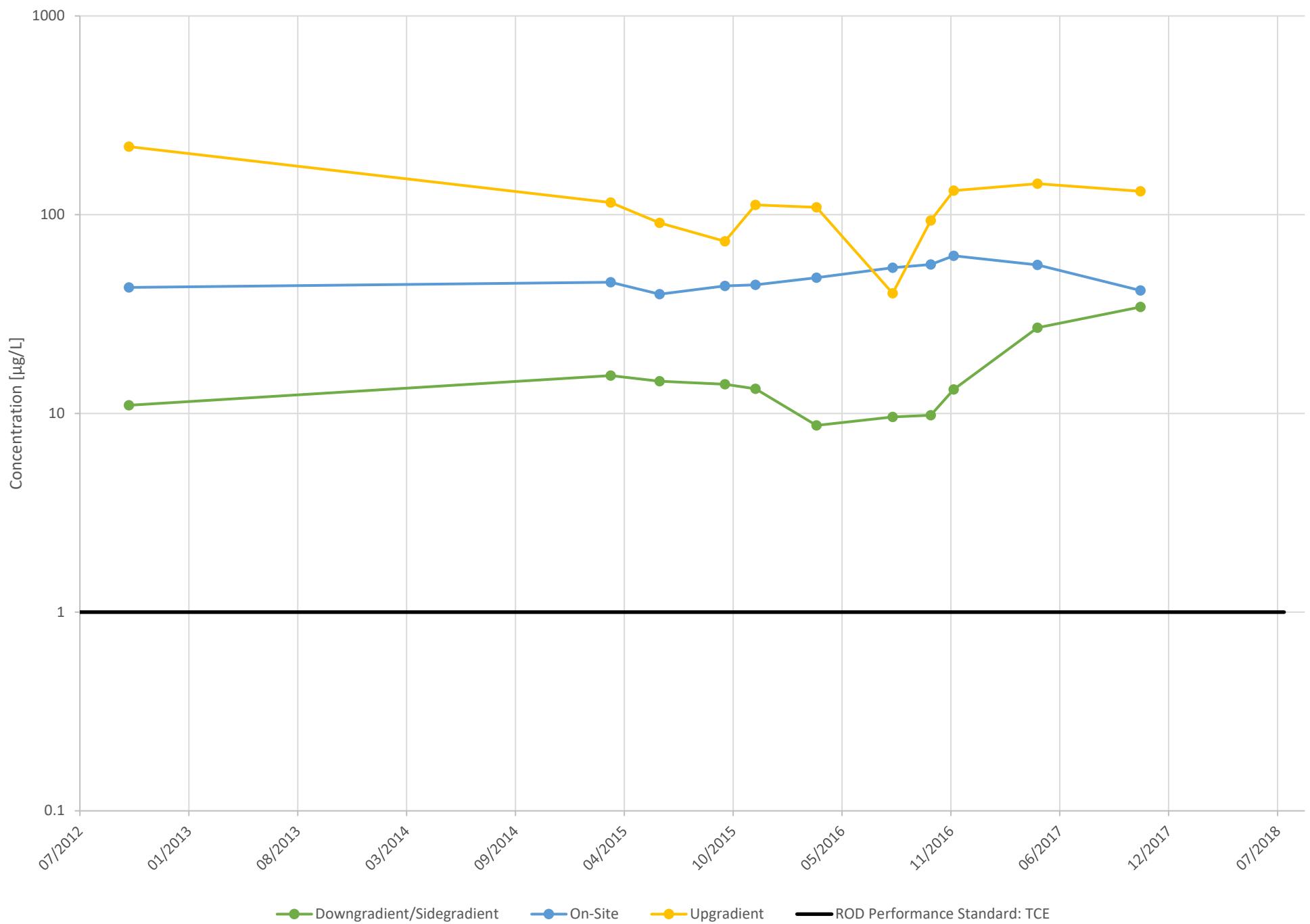


Figure 12b: Upgradient Monitoring Wells  
TCE Shallow Groundwater Concentrations since 2012

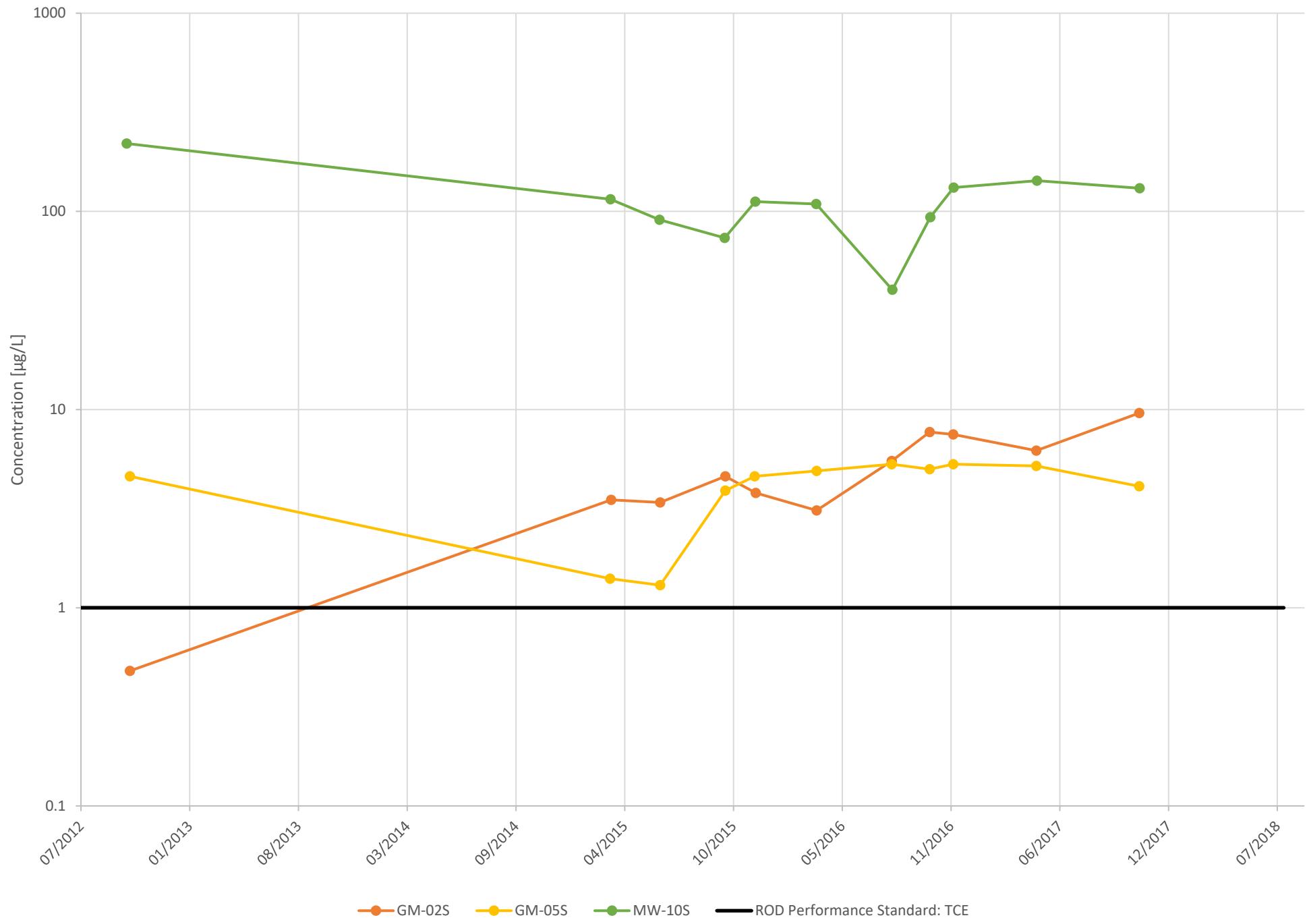


Figure 12c: On-Site Monitoring Wells  
TCE Shallow Groundwater Concentrations since 2012

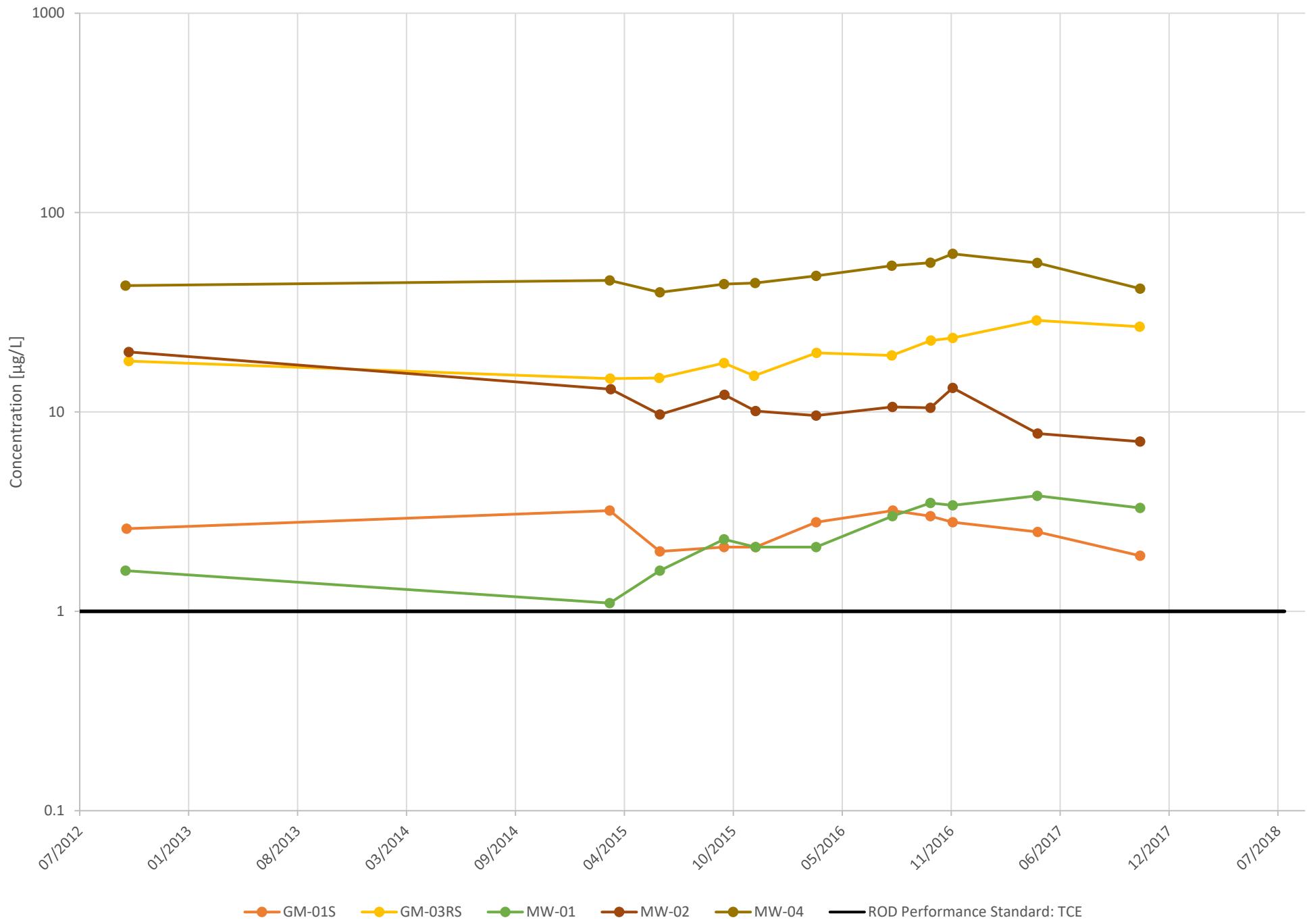


Figure 12d: Downgradient/Sidegradient Monitoring Wells  
TCE Shallow Groundwater Concentrations since 2012

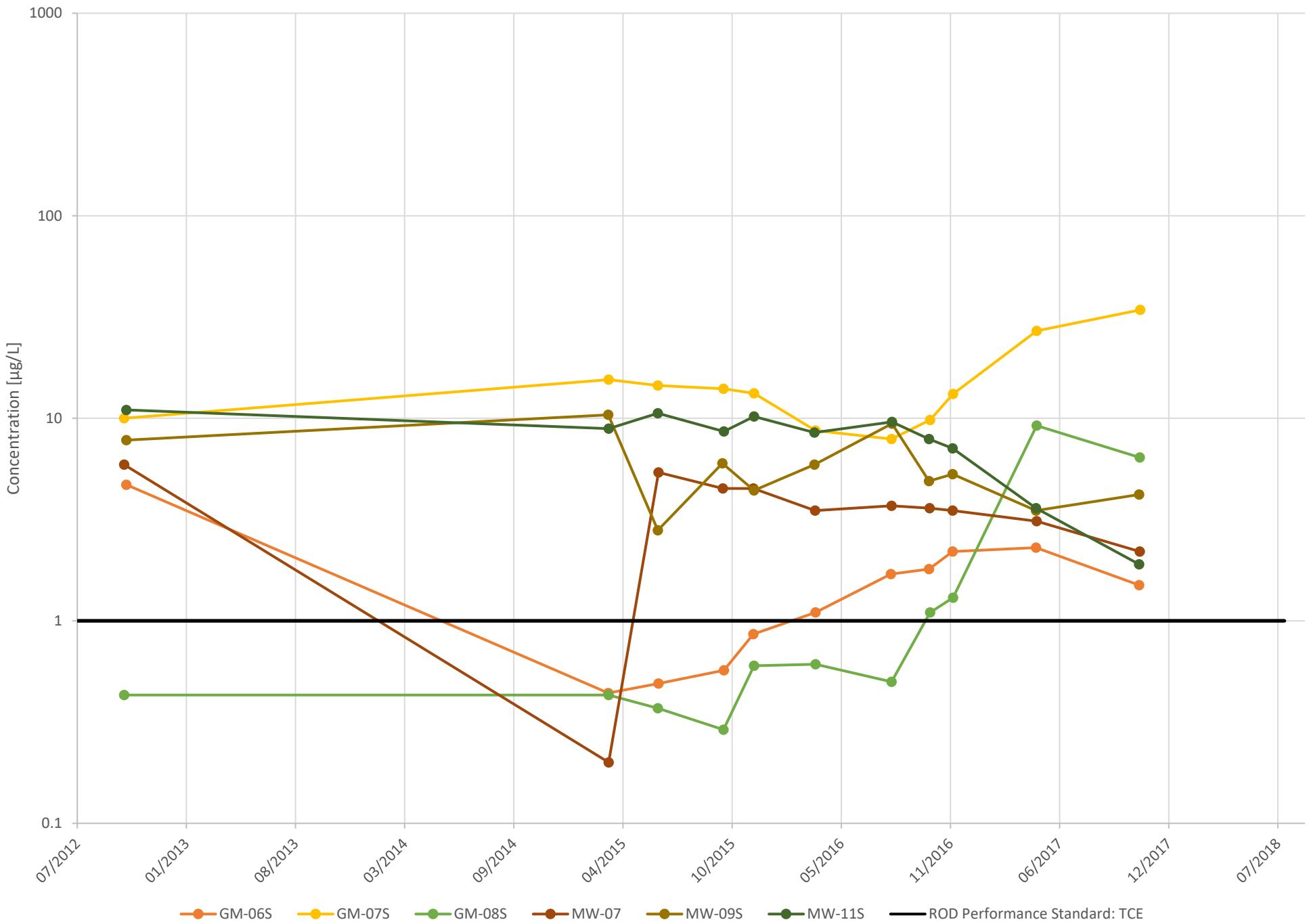


Figure 13a: Highest cDCE Shallow Groundwater Concentration  
by Monitoring Well Hydraulic Position since 2012

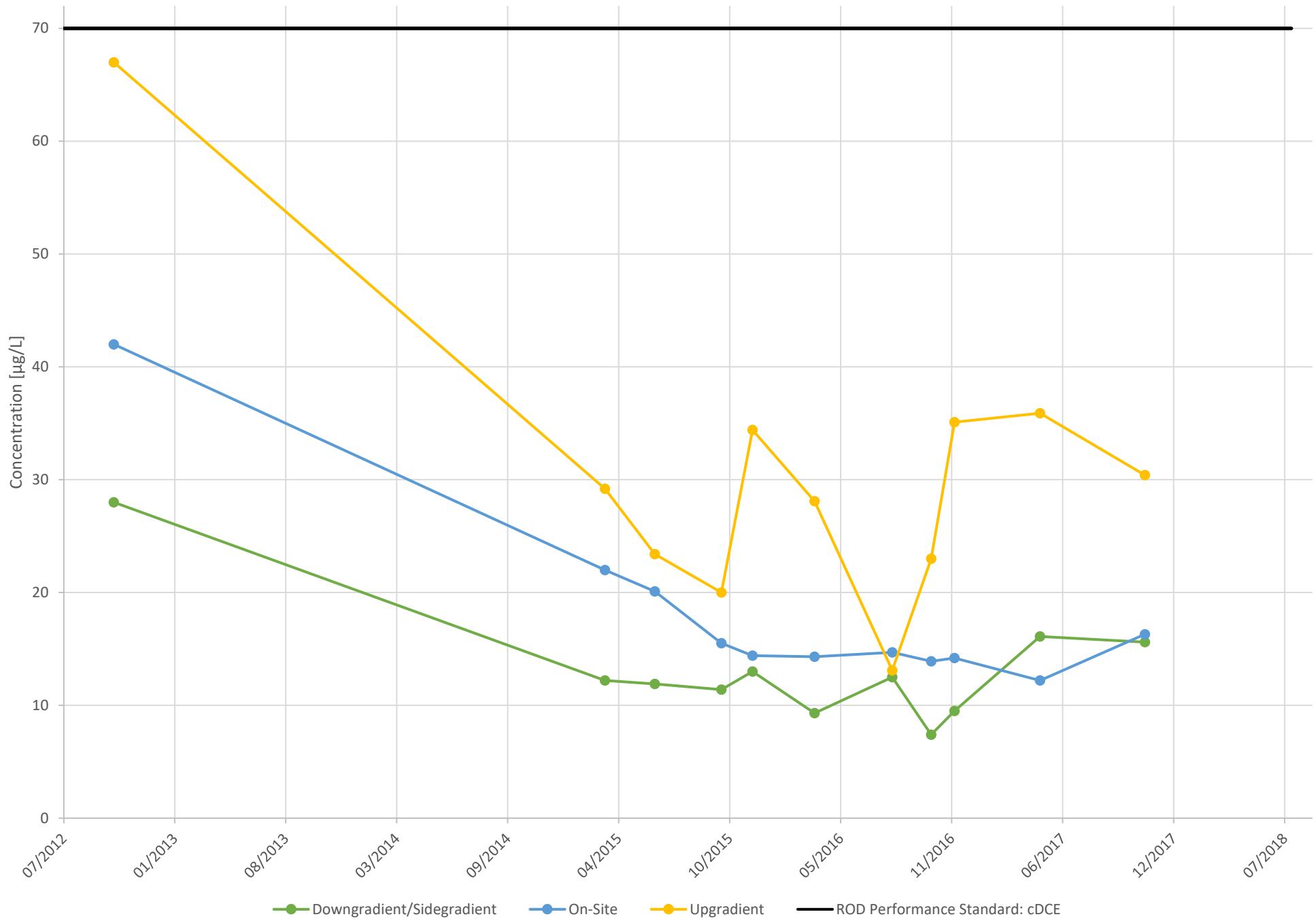


Figure 13b: Upgradient Monitoring Wells  
cDCE Shallow Groundwater Concentrations since 2012

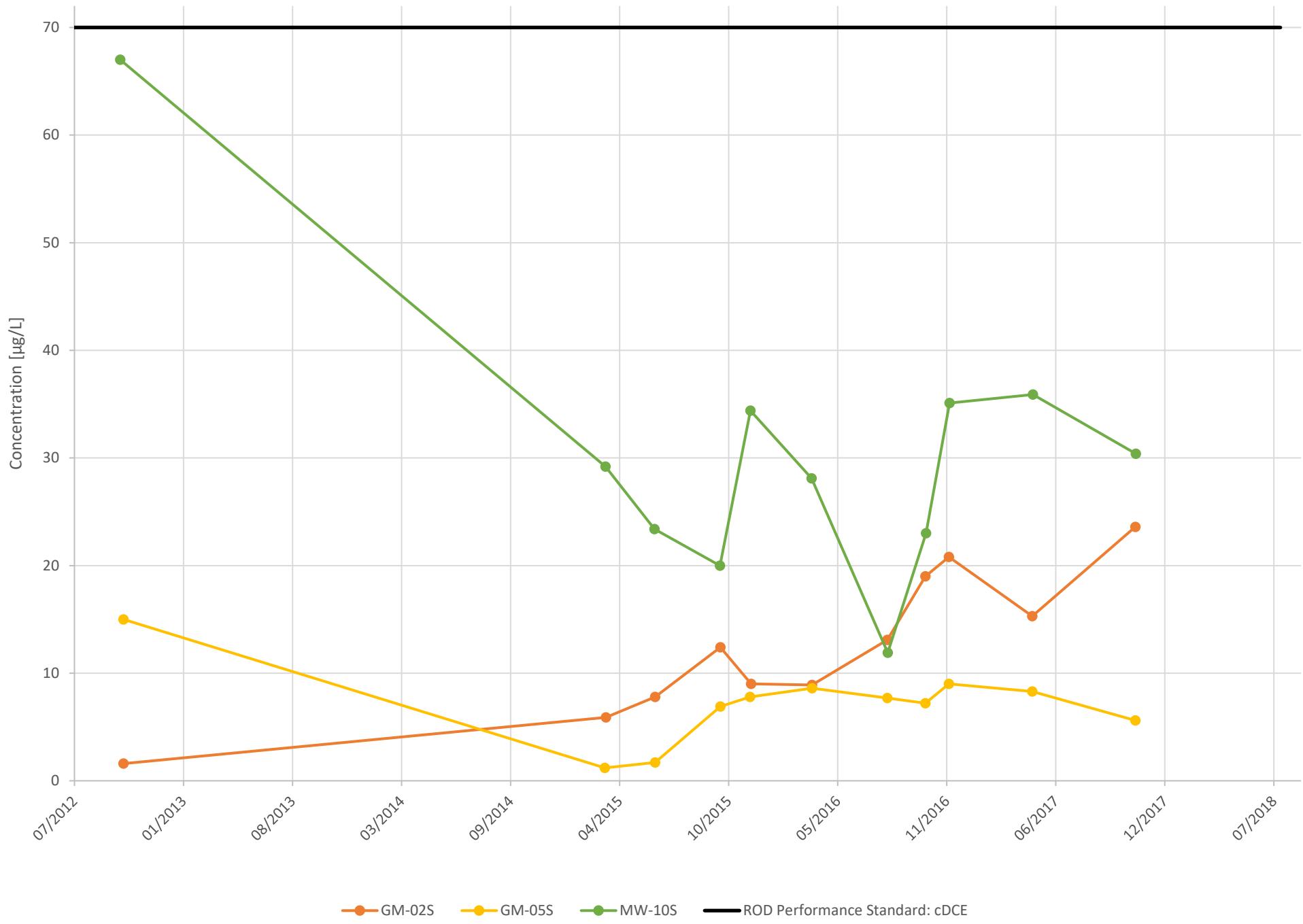


Figure 13c: On-Site Monitoring Wells  
cDCE Shallow Groundwater Concentrations since 2012

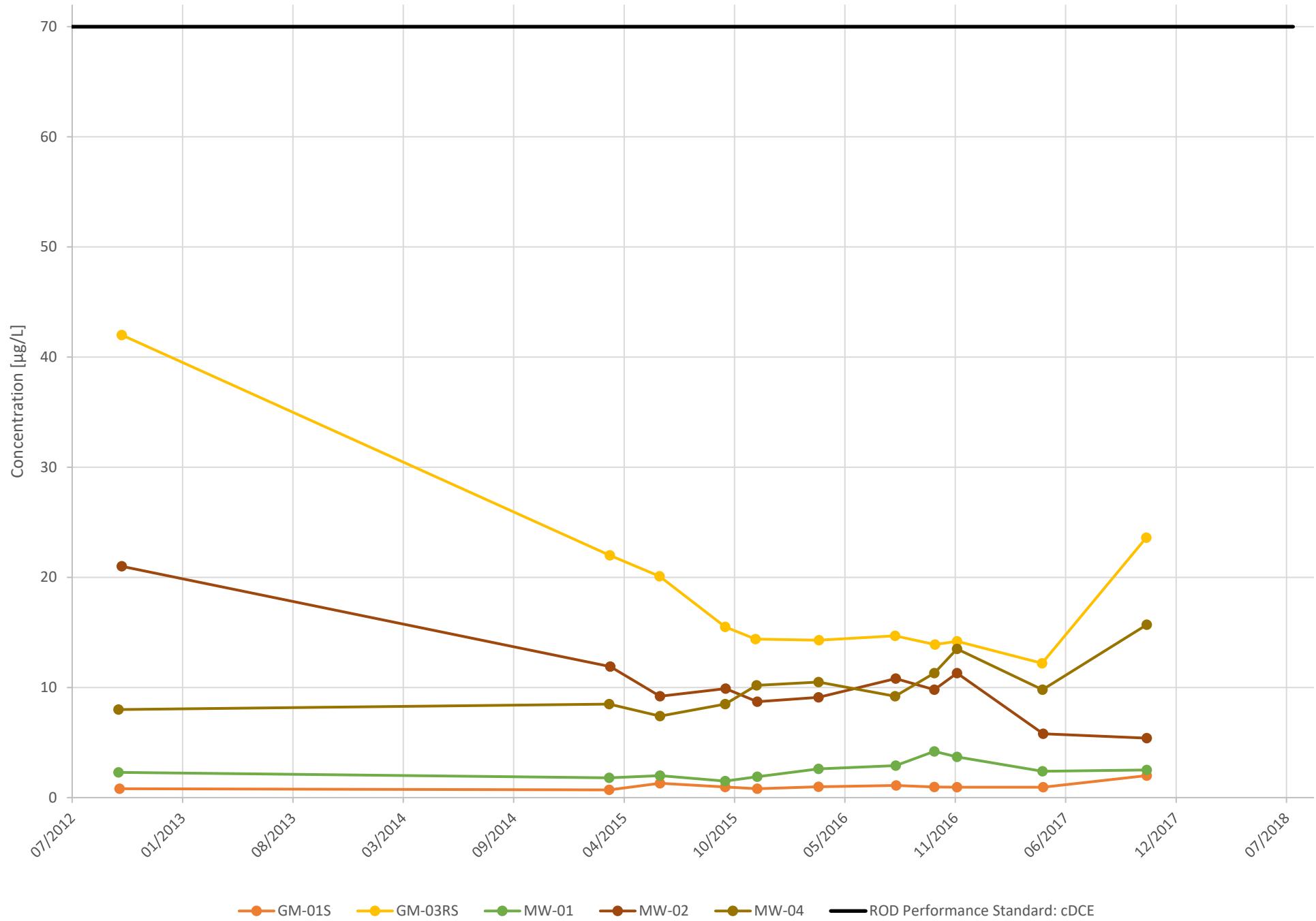


Figure 13d: Downgradient/Sidegradient Monitoring Wells  
cDCE Shallow Groundwater Concentrations since 2012

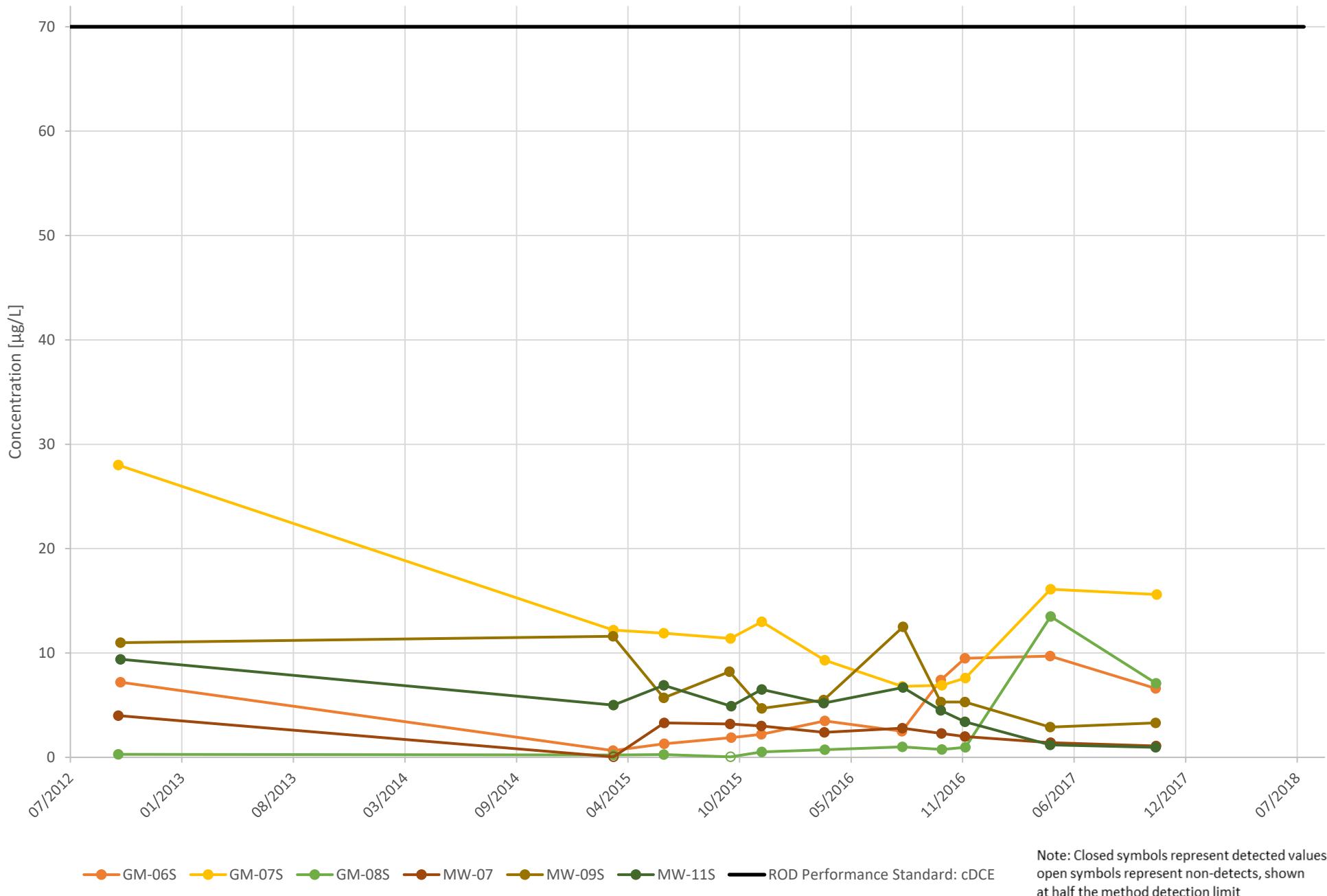


Figure 14a: Highest VC Shallow Groundwater Concentration  
by Monitoring Well Hydraulic Position since 2012

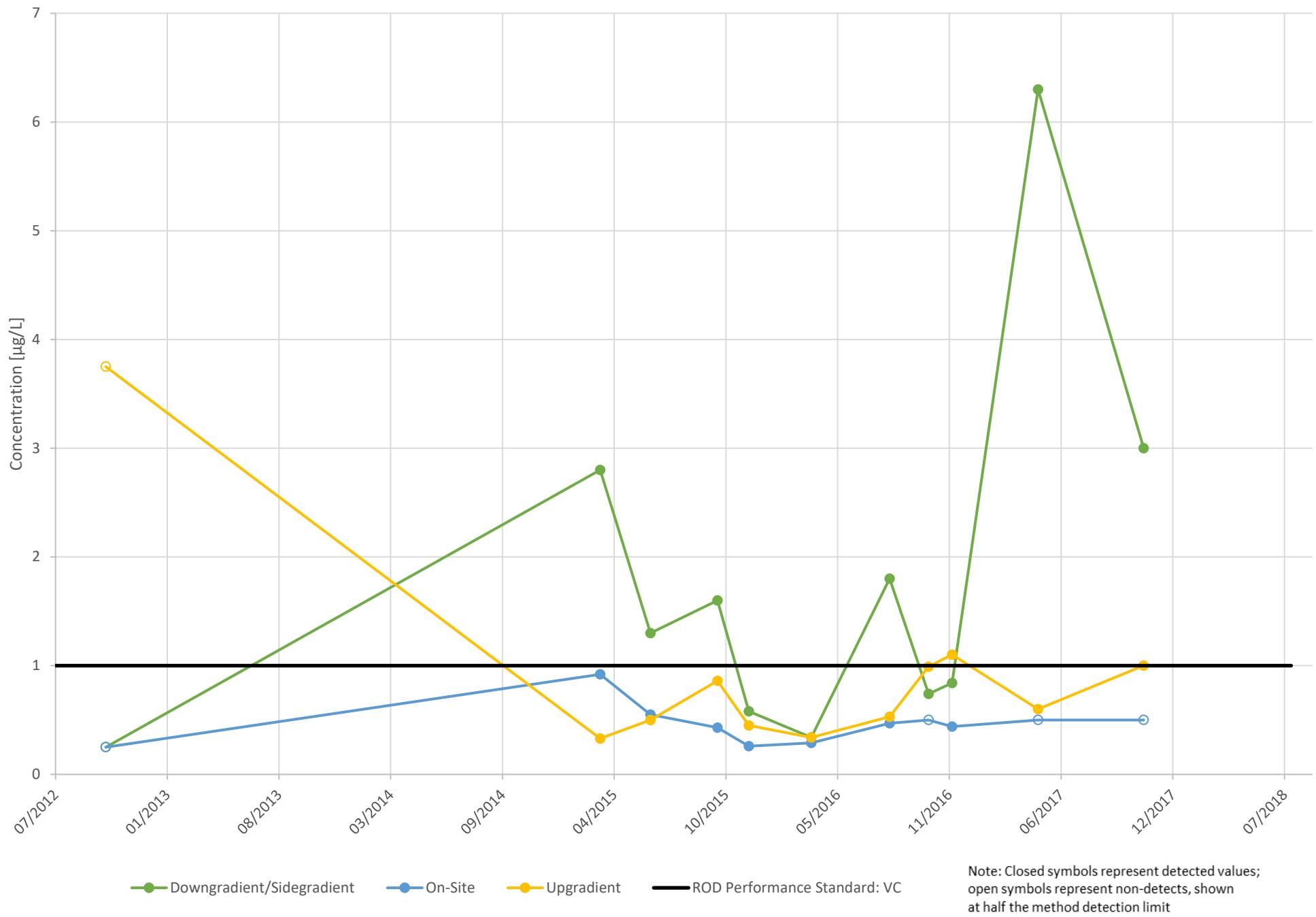


Figure 14b: Upgradient Monitoring Wells  
VC Shallow Groundwater Concentrations since 2012

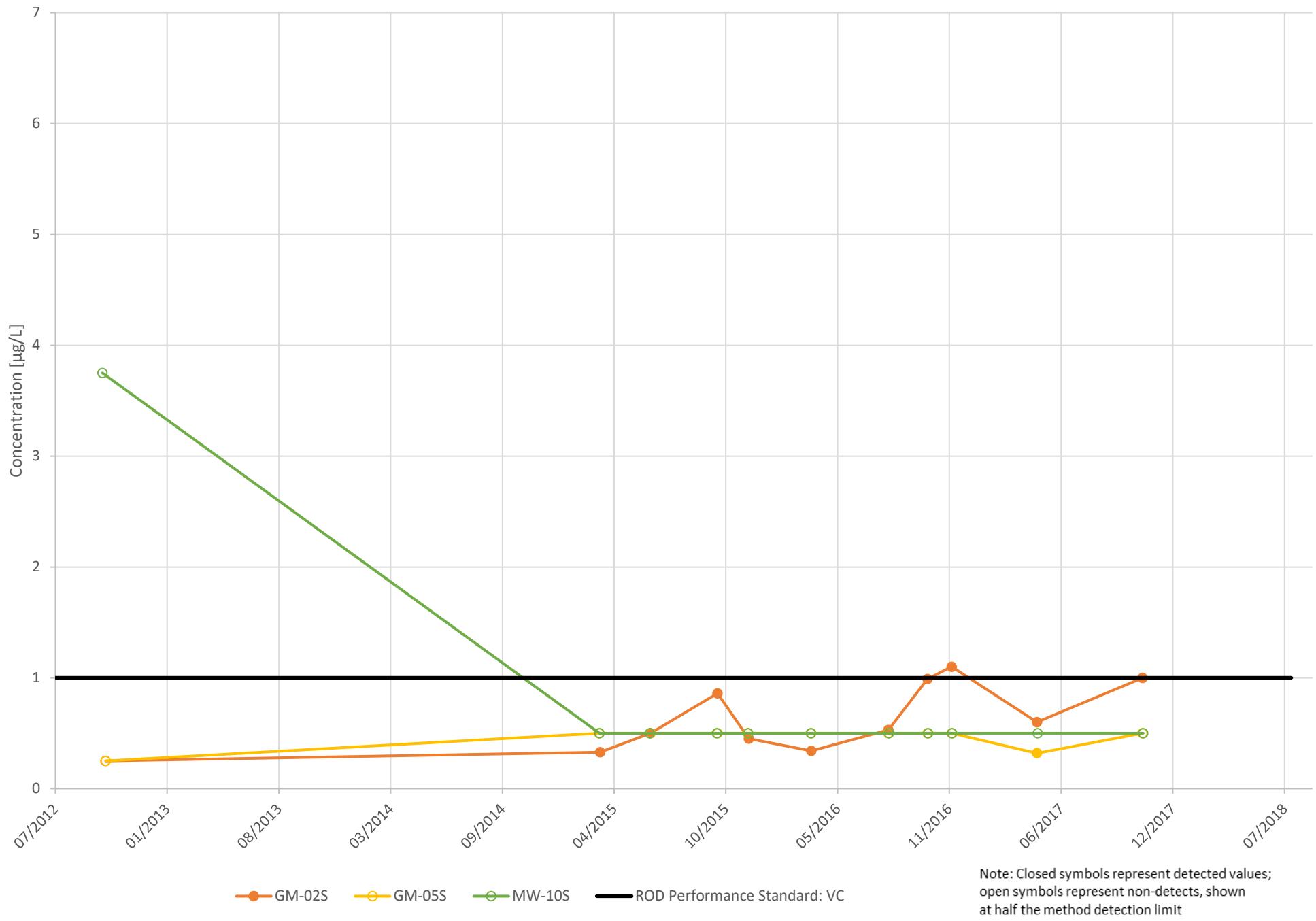


Figure 14c: On-Site Monitoring Wells  
VC Shallow Groundwater Concentrations since 2012

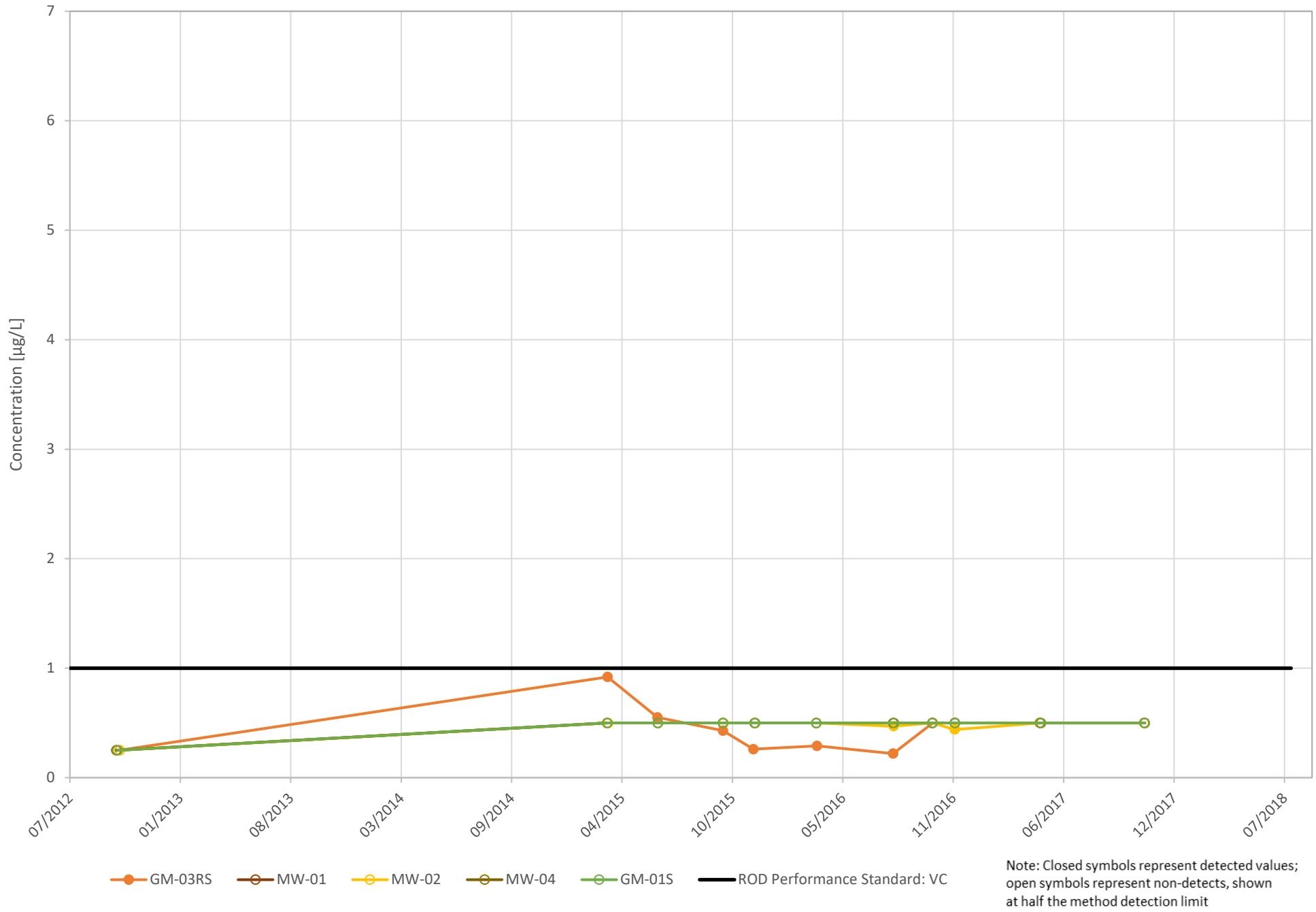


Figure 14d: Downgradient/Sidegradient Monitoring Wells  
VC Shallow Groundwater Concentrations since 2012

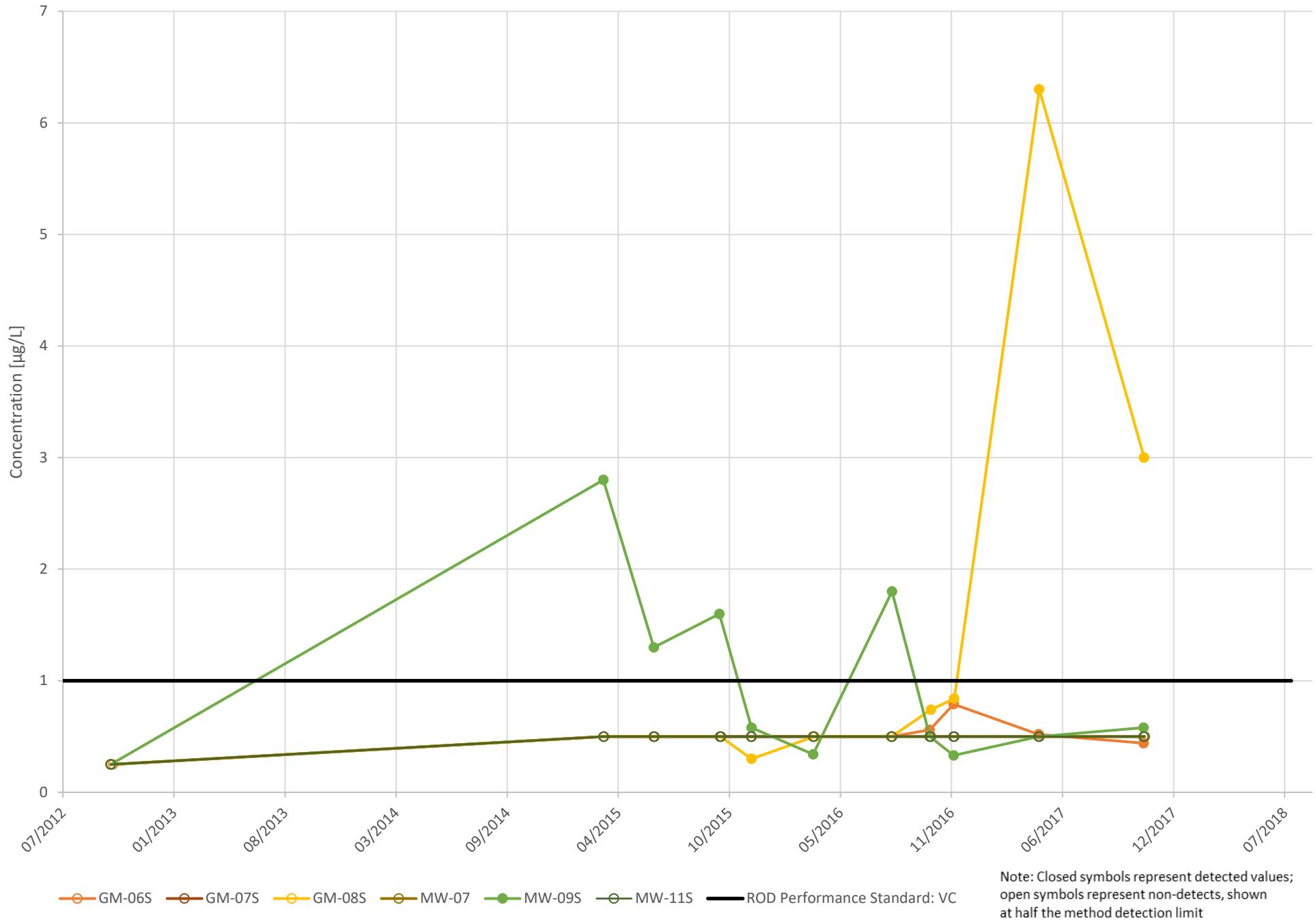


Figure 15a: Highest 1,4-Dioxane Shallow Groundwater Concentration  
by Monitoring Well Hydraulic Position since 2015

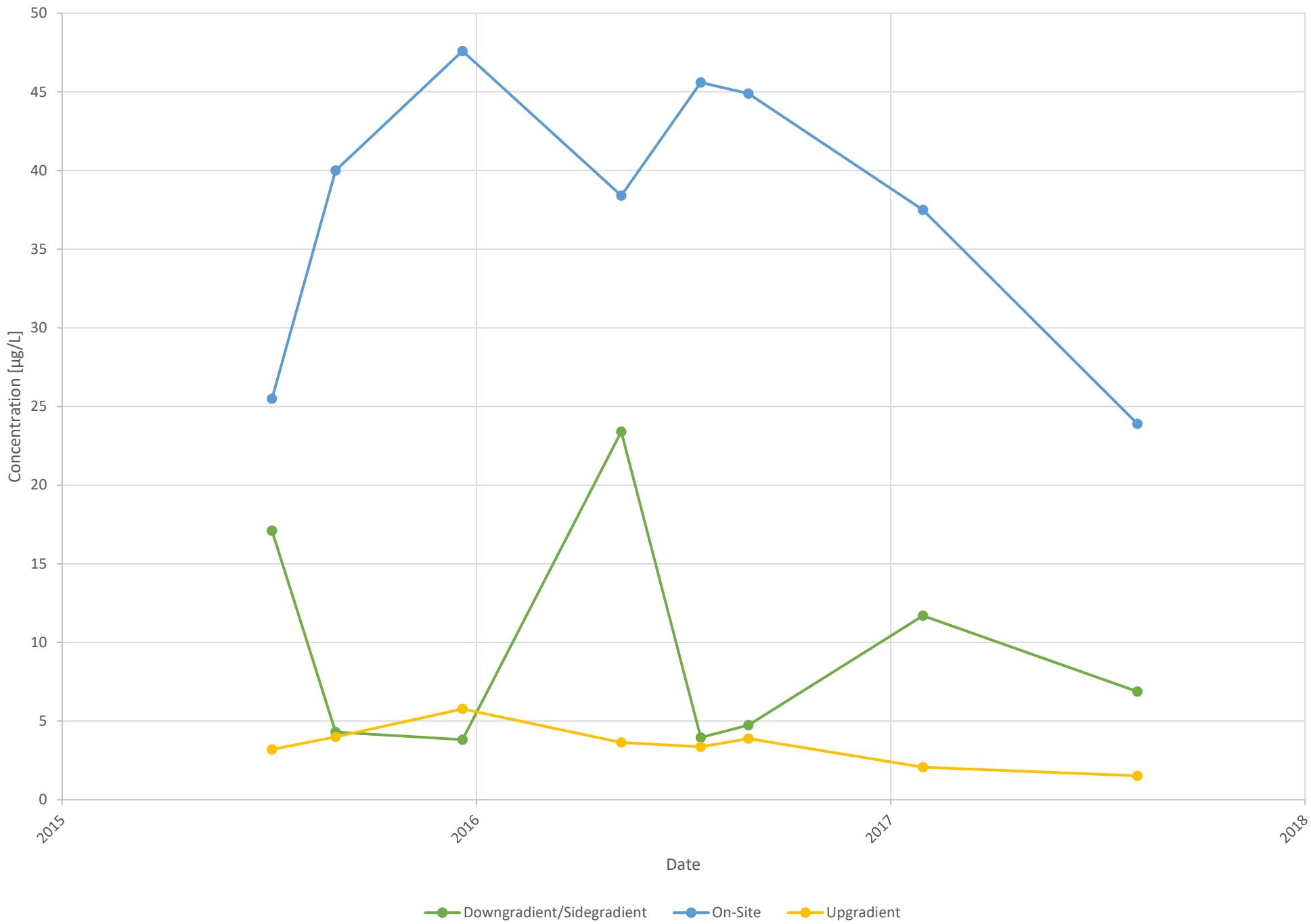


Figure 15b: Upgradient Monitoring Wells  
1,4-Dioxane Shallow Groundwater Concentrations since 2015

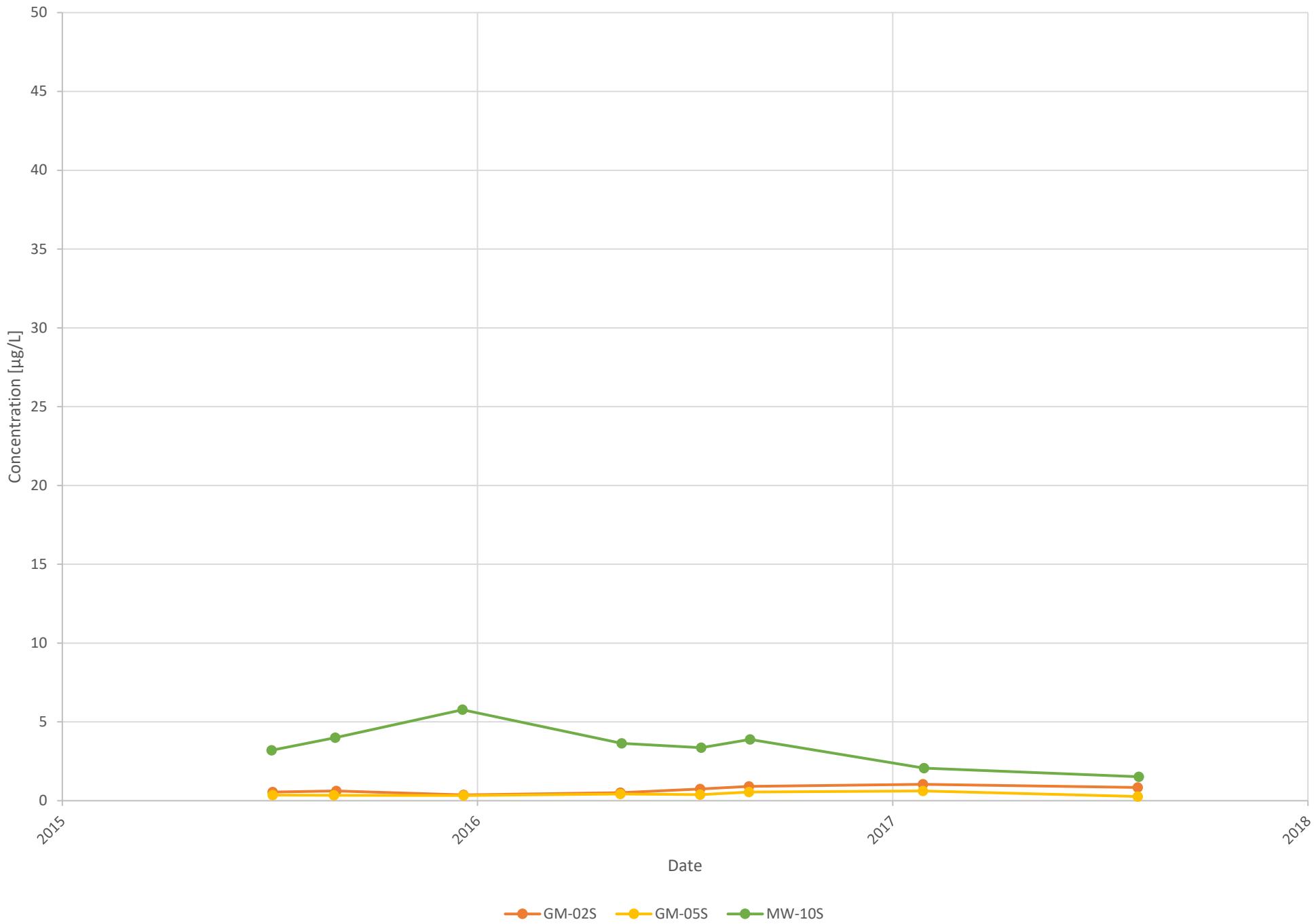


Figure 15c: On-Site Monitoring Wells  
1,4-Dioxane Shallow Groundwater Concentrations since 2015

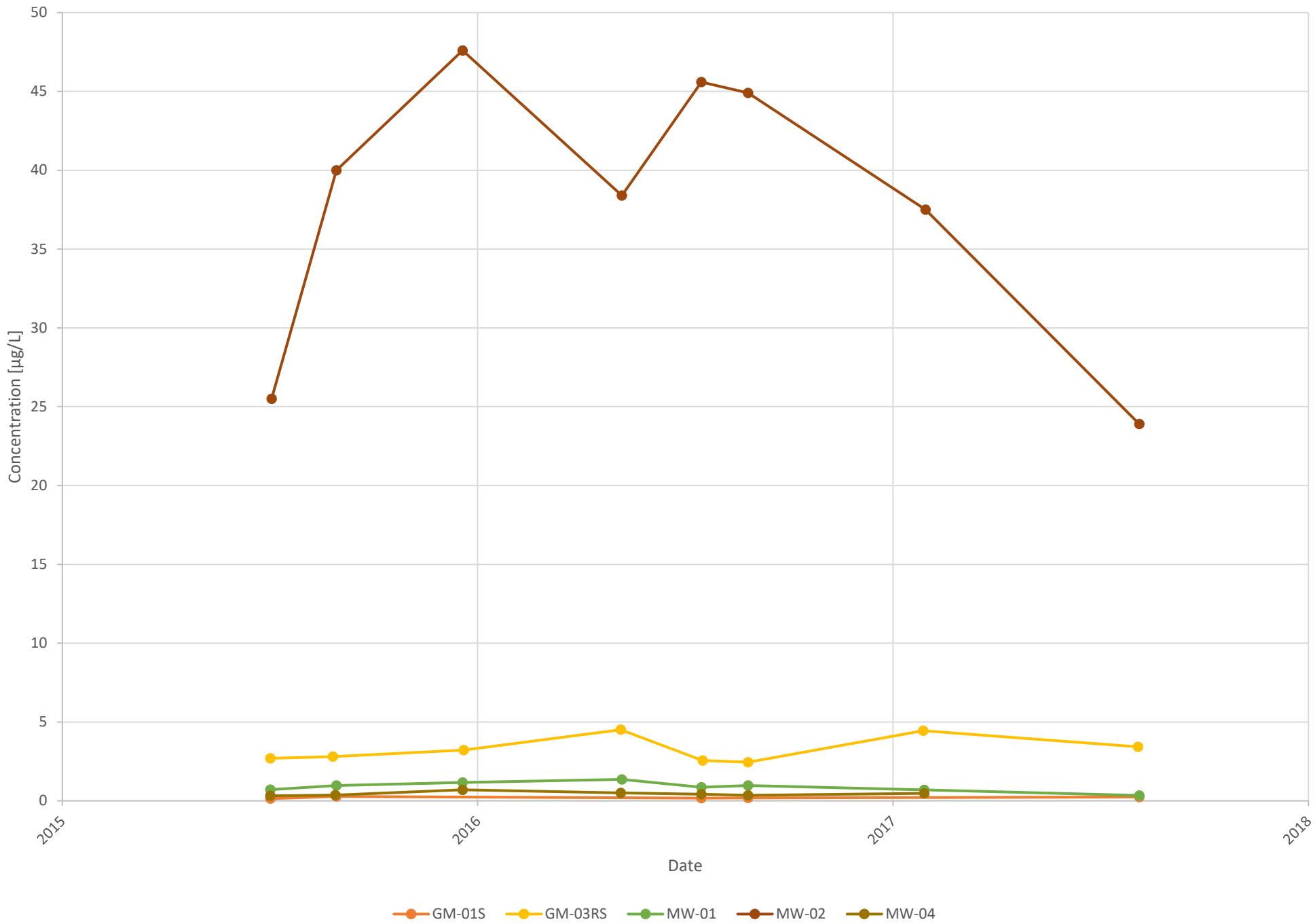
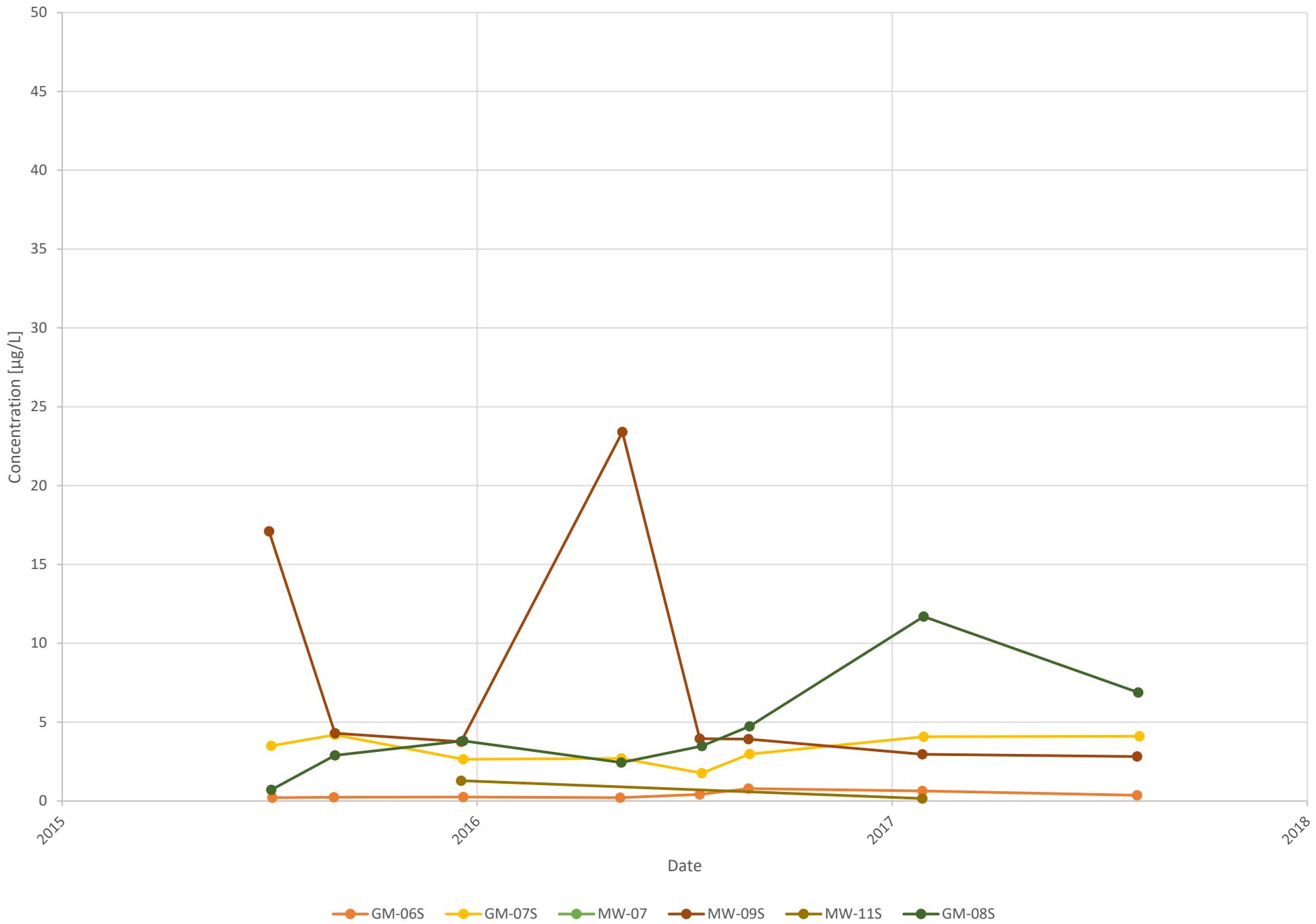


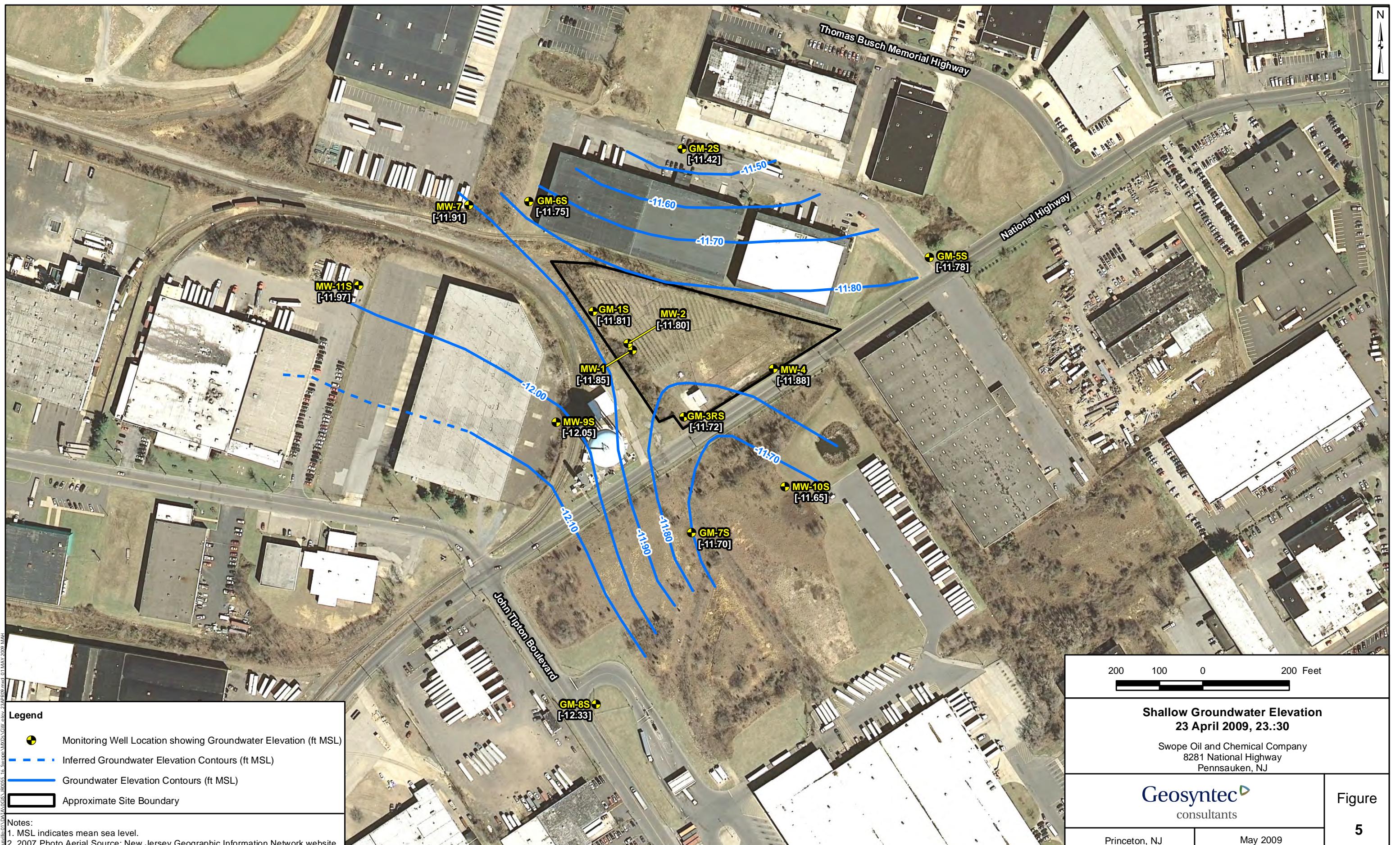
Figure 15d: Downgradient/Sidegradient Monitoring Wells  
1,4-Dioxane Shallow Groundwater Concentrations since 2015

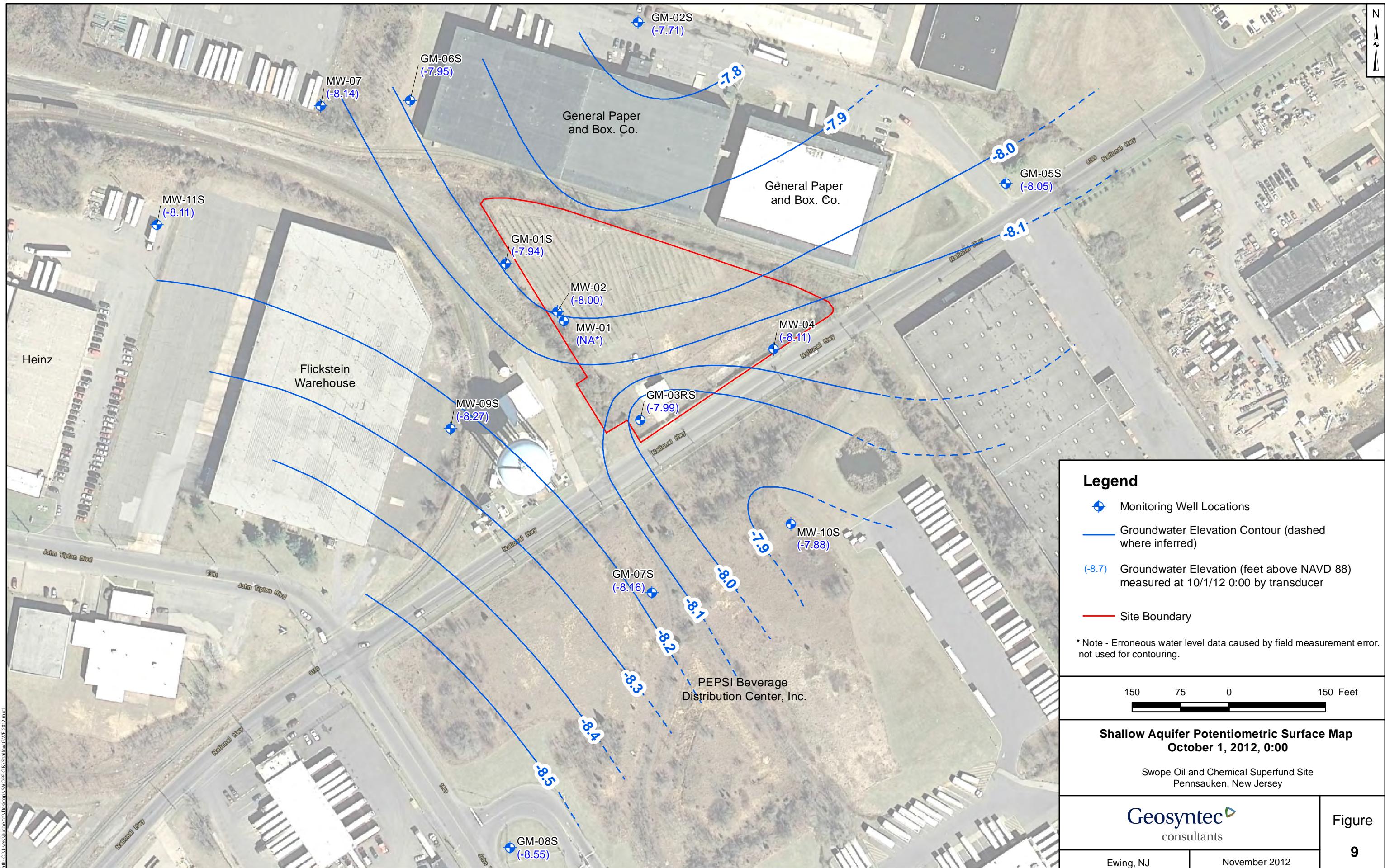


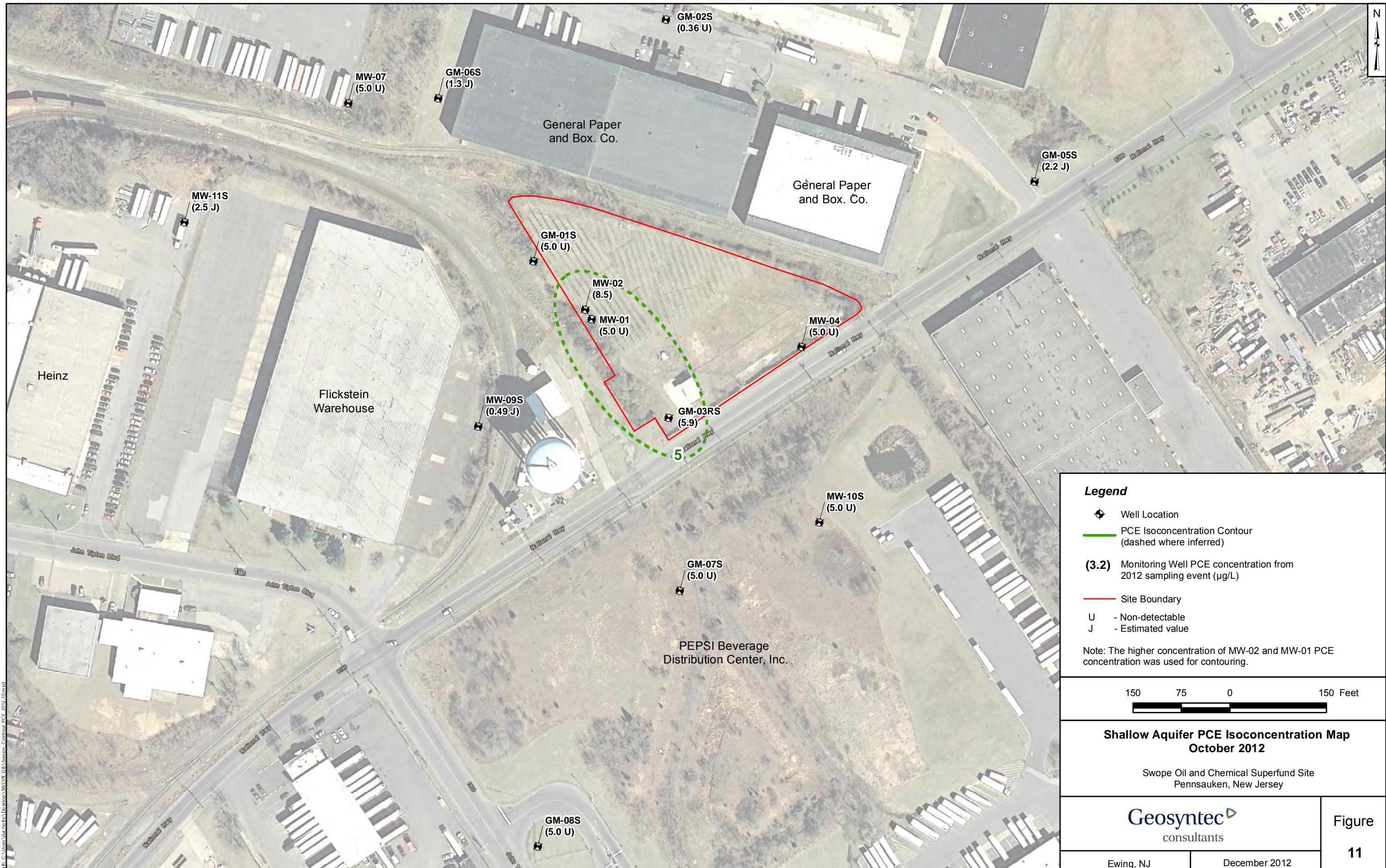
## **APPENDICES**

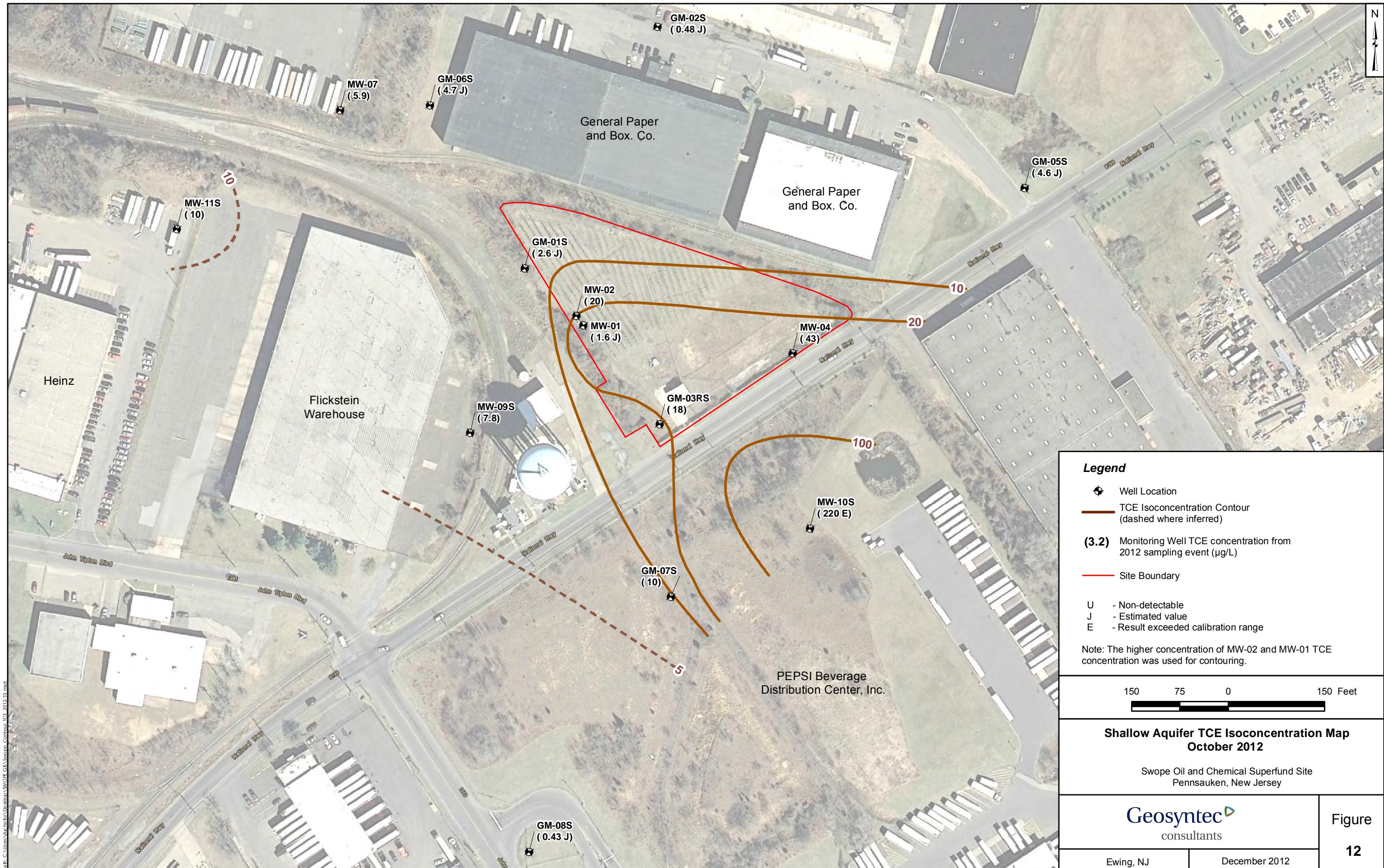
## **APPENDIX A**

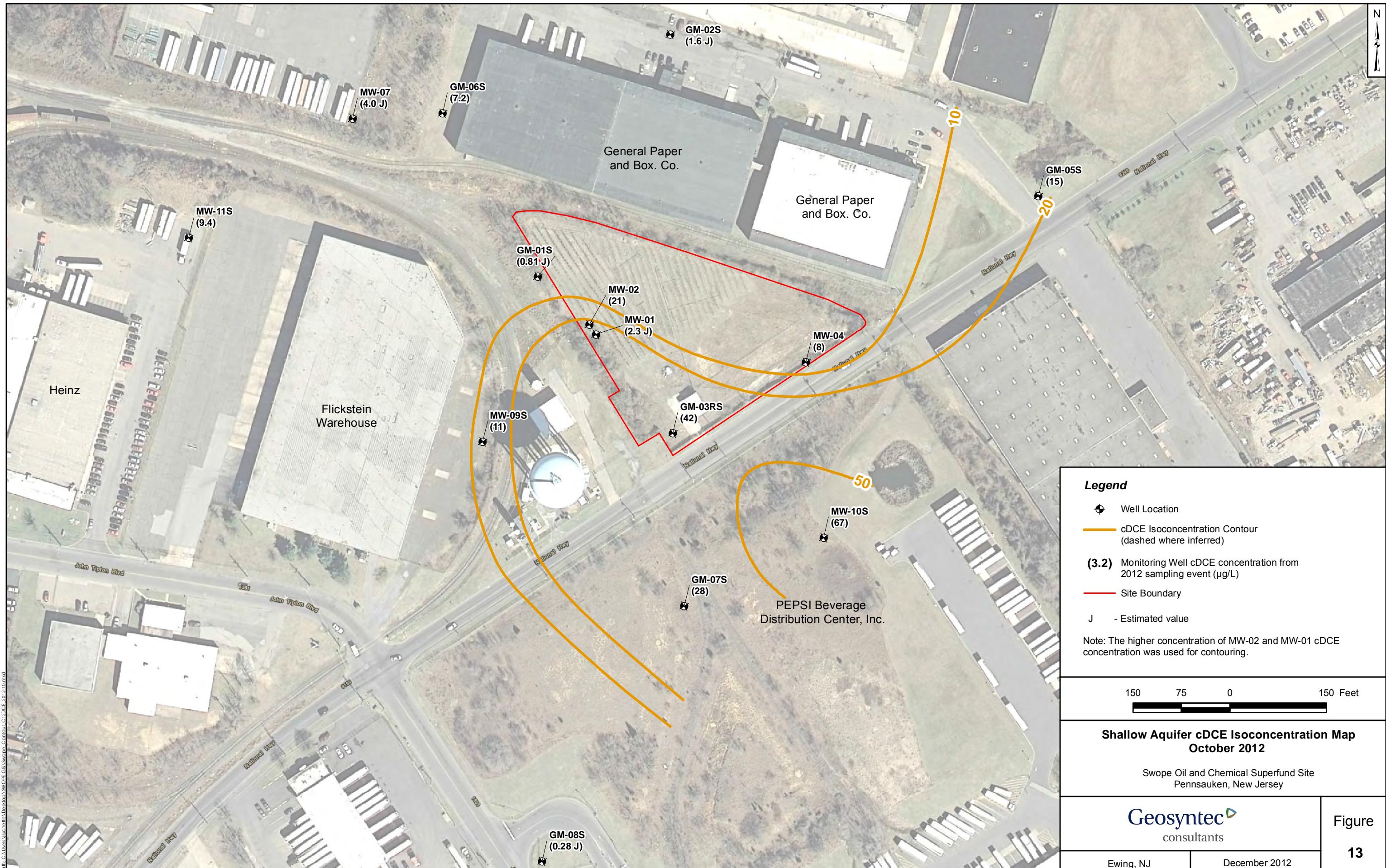
### **Selected Historical Tables and Figures**

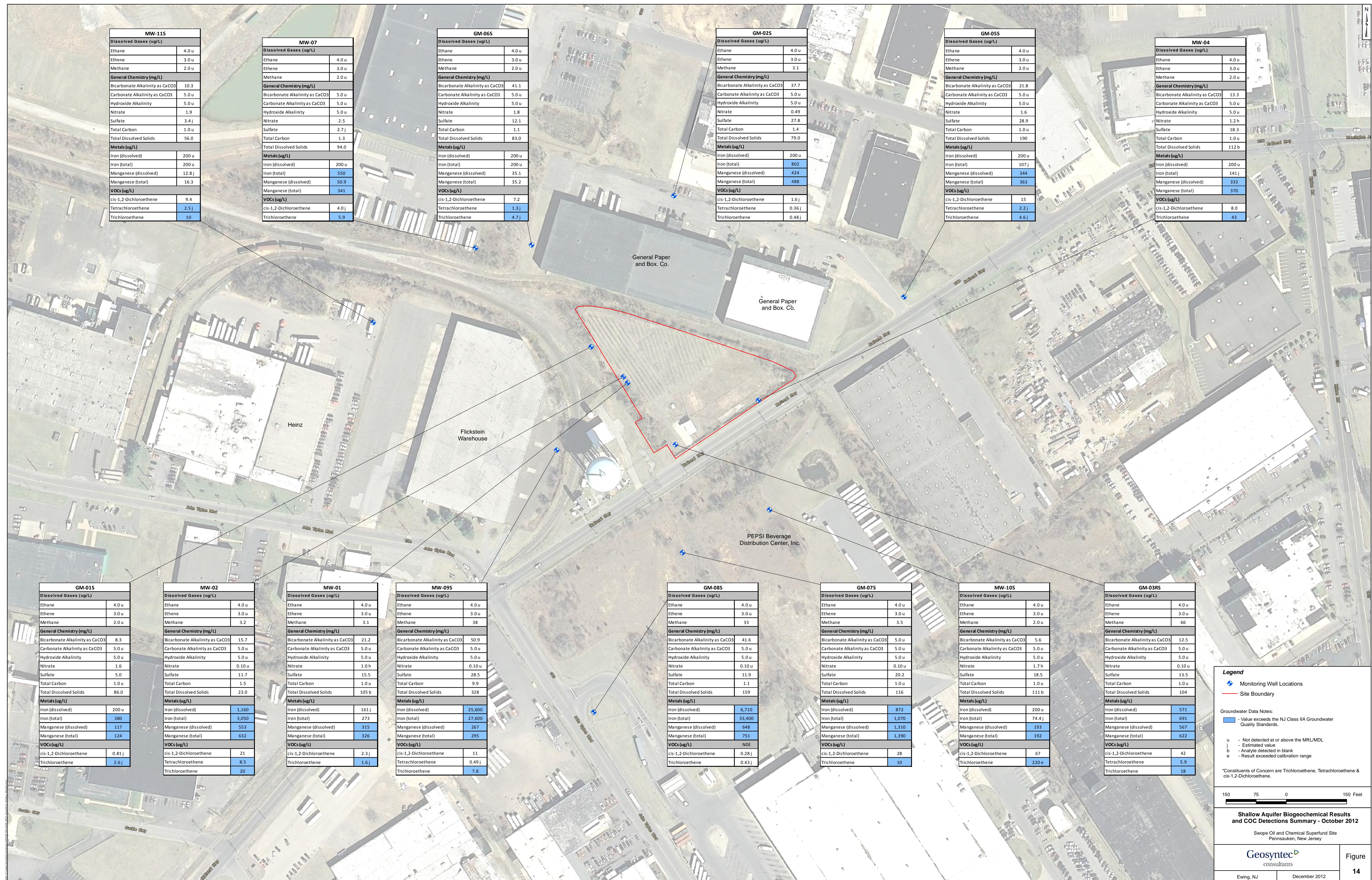


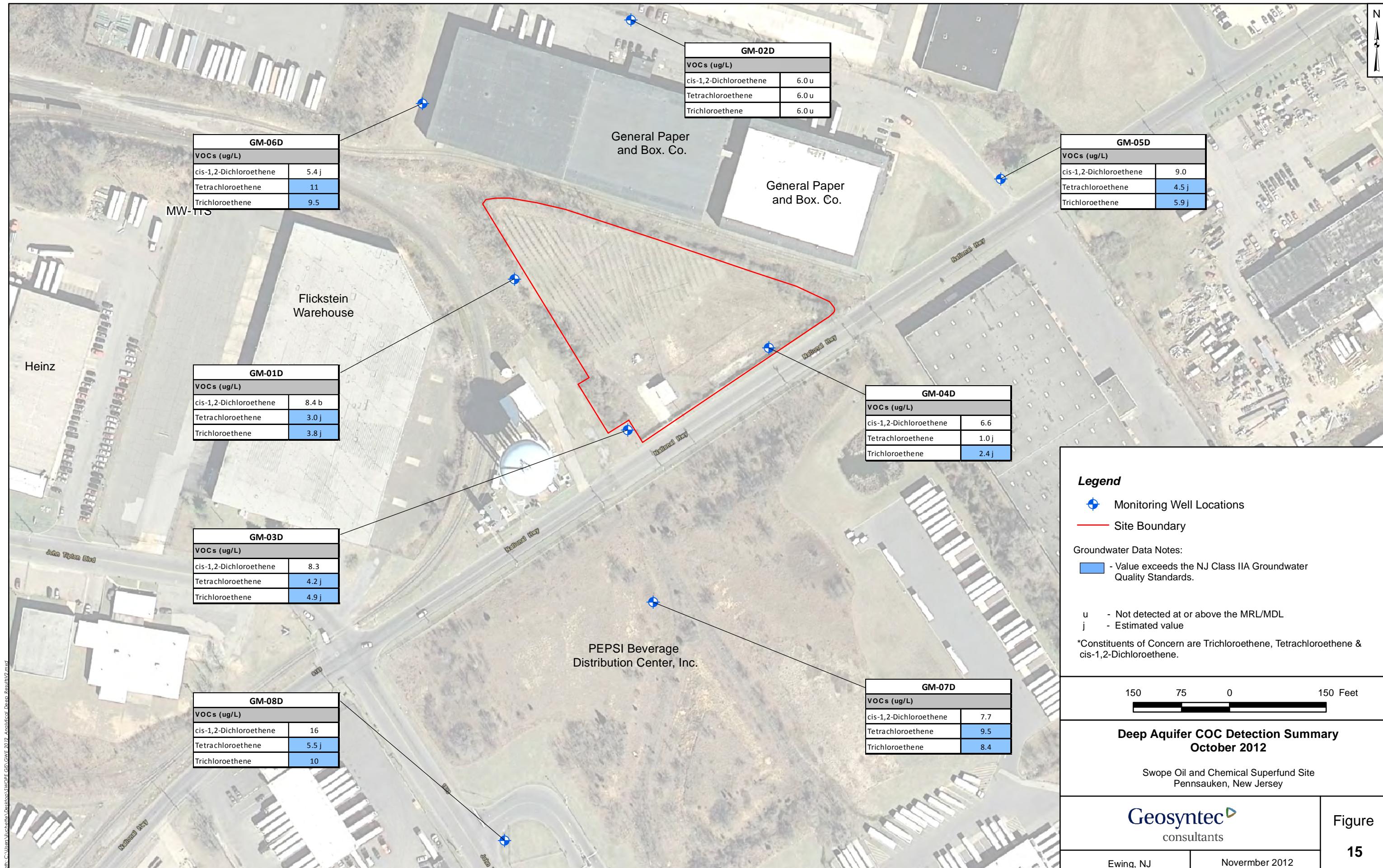












## **APPENDIX B**

### **2017 Monitoring Well Low-Flow Purging and Sampling Records**









## **SITE NAME: SWOPE Superfund**

## Monitoring Well Low-Flow Purging & Sampling Record

Geosyntec Consultants, Inc.

7 Graphics Drive, Suite 106  
Ewing, New Jersey 08628  
Phone: 609-895-1400  
Fax: 609-895-1401

**Geosyntec**  
consultants

engineers | scientists | innovators

Well ID: GM-06S  
Pump Intake Depth [ft]: 118.5  
Project Name: Swope Superfund  
Sampling Program: MNA  
Date: 5/2/2017  
Recorded By: MJ  
Sample ID: GM-06S.20170502  
Duplicate ID: N/A

Well Diameter [in]: 4  
Total Depth of Well [ft]:                   
Initial Depth to Water [ft]: 65.65 Time: 10:25  
Casing Volume [gal]:                   
Final Depth to Water [ft]: 65.65 Time: 11:10  
Method of Purging: Low Flow Bladder Pump (dedicated to well)  
Method of Sampling: Low Flow Bladder Pump (dedicated to well)  
Weather: partly cloudy, 70s

## FIELD PARAMETERS

**Notes: (well condition, nearby activities or changes in land use, odors, problems, deviations from plan, etc.)**

Used YSI and turbidity meter: C

Sample time at 11:10



























**SITE NAME: SWOPE Superfund**

## Monitoring Well Low-Flow Purging & Sampling Record

Geosyntec Consultants, Inc.

7 Graphics Drive, Suite 106  
Ewing, New Jersey 08628  
Phone: 609-895-1400  
Fax: 609-895-1401

**Geosyntec** ▶

### **consultants**

engineers | scientists | innovators

Well ID: GM-06S  
Pump Intake Depth [ft]: 118.5  
Project Name: Swope Superfund  
Sampling Program: MNA  
Date: 11/7/2017  
Recorded By: NJ  
Sample ID: GM-06S.20171107  
Duplicate ID: N/A

Well Diameter [in]: 4 in  
Total Depth of Well [ft]:                   
Initial Depth to Water [ft]: 66.00 Time: 01:34  
Casing Volume [gal]:                   
Final Depth to Water [ft]: 66.00 Time: 11:55  
Method of Purging: Low Flow Bladder Pump (dedicated to well)  
Method of Sampling: Low Flow Bladder Pump (dedicated to well)  
Weather: cloudy, 50s

## FIELD PARAMETERS

**Notes: (well condition, nearby activities or changes in land use, odors, problems, deviations from plan, etc.)**

Used YSI and turbidity meter: A and C

Sample time at 11:45



















## **APPENDIX C (ON CD)**

**Analytical Data Packages and Data Validation Reports**

## **APPENDIX D**

### **Mann-Kendall Analysis Results**

**Appendix D: Mann-Kendall Analysis Results**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017) Annual MNA Report**

Geosyntec Consultants

Location	Analyte	N	Detection Frequency	Mann-Kendall (S)	Z Statistic	COV	Probability	Confidence in Trend	Concentration Trend	Comment
GM-01S	cis-1,2-Dichloroethene	10	100	8	--	0.34	(0.242, 0.3)	(0.7, 0.758)	No Trend	exact p-value could not be computed
GM-01S	Ethene	10	30	--	--	--	--	--	NA	
GM-01S	Tetrachloroethene	10	100	22	--	0.12	(0.023, 0.036)	(0.964, 0.977)	Increasing	exact p-value could not be computed
GM-01S	Trichloroethene	10	100	-4	--	0.20	(0.364, 0.431)	(0.569, 0.636)	Stable	exact p-value could not be computed
GM-01S	Vinyl Chloride	10	0	--	--	--	--	--	NA	
GM-02S	cis-1,2-Dichloroethene	10	100	35	--	0.44	0.000	1.000	Increasing	
GM-02S	Ethene	10	20	--	--	--	--	--	NA	
GM-02S	Tetrachloroethene	10	100	30	--	0.34	(0.0023, 0.0046)	(0.9954, 0.9977)	Increasing	exact p-value could not be computed
GM-02S	Trichloroethene	10	100	27	--	0.40	0.008	0.992	Increasing	
GM-02S	Vinyl Chloride	10	100	25	--	0.43	0.014	0.986	Increasing	
GM-03RS	cis-1,2-Dichloroethene	10	100	-25	--	0.19	0.014	0.986	Decreasing	
GM-03RS	Ethene	10	20	--	--	--	--	--	NA	
GM-03RS	Tetrachloroethene	10	100	9	--	0.11	0.242	0.758	No Trend	
GM-03RS	Trichloroethene	10	100	39	--	0.25	0.000	1.000	Increasing	
GM-03RS	Vinyl Chloride	10	60	11	--	0.52	0.190	0.810	No Trend	
GM-05S	cis-1,2-Dichloroethene	10	100	17	--	0.43	0.078	0.922	Probably Increasing	
GM-05S	Ethene	10	10	--	--	--	--	--	NA	
GM-05S	Tetrachloroethene	10	100	-11	--	0.21	0.190	0.810	Stable	
GM-05S	Trichloroethene	10	100	24	--	0.37	(0.014, 0.023)	(0.977, 0.986)	Increasing	exact p-value could not be computed
GM-05S	Vinyl Chloride	10	10	--	--	--	--	--	NA	
GM-06S	cis-1,2-Dichloroethene	10	100	37	--	0.76	0.000	1.000	Increasing	
GM-06S	Ethene	10	10	--	--	--	--	--	NA	
GM-06S	Tetrachloroethene	10	90	36	--	0.44	(0.00018, 0.00047)	(0.99953, 0.99982)	Increasing	exact p-value could not be computed
GM-06S	Trichloroethene	10	100	37	--	0.54	0.000	1.000	Increasing	
GM-06S	Vinyl Chloride	10	40	--	--	--	--	--	NA	
GM-07S	cis-1,2-Dichloroethene	10	100	-1	--	0.30	0.500	0.500	Stable	
GM-07S	Ethene	10	30	--	--	--	--	--	NA	
GM-07S	Tetrachloroethene	10	100	-8	--	0.24	(0.242, 0.3)	(0.7, 0.758)	Stable	exact p-value could not be computed
GM-07S	Trichloroethene	10	100	-1	--	0.53	0.500	0.500	Stable	
GM-07S	Vinyl Chloride	10	0	--	--	--	--	--	NA	
GM-08S	cis-1,2-Dichloroethene	10	80	30	--	1.66	(0.0023, 0.0046)	(0.9954, 0.9977)	Increasing	exact p-value could not be computed
GM-08S	Ethene	10	50	28	--	1.22	(0.0046, 0.0083)	(0.9917, 0.9954)	Increasing	exact p-value could not be computed
GM-08S	Tetrachloroethene	10	10	--	--	--	--	--	NA	
GM-08S	Trichloroethene	10	100	33	--	1.49	0.001	0.999	Increasing	
GM-08S	Vinyl Chloride	10	50	7	--	1.11	0.300	0.700	No Trend	
MW-01	cis-1,2-Dichloroethene	10	100	21	--	0.34	0.036	0.964	Increasing	
MW-01	Ethene	10	10	--	--	--	--	--	NA	
MW-01	Tetrachloroethene	10	100	12	--	0.12	(0.146, 0.19)	(0.81, 0.854)	No Trend	exact p-value could not be computed
MW-01	Trichloroethene	10	100	32	--	0.35	(0.0011, 0.0023)	(0.9977, 0.9989)	Increasing	exact p-value could not be computed
MW-01	Vinyl Chloride	10	0	--	--	--	--	--	NA	
MW-02	cis-1,2-Dichloroethene	10	100	-15	--	0.23	0.108	0.892	Stable	
MW-02	Ethene	10	10	--	--	--	--	--	NA	
MW-02	Tetrachloroethene	10	100	-40	--	0.48	(0.000015, 0.000058)	(0.999942, 0.999985)	Decreasing	exact p-value could not be computed
MW-02	Trichloroethene	10	100	-15	--	0.19	0.108	0.892	Stable	
MW-02	Vinyl Chloride	10	20	--	--	--	--	--	NA	

**Appendix D: Mann-Kendall Analysis Results**  
**Swope Oil and Chemical Company Superfund Site**  
**Year 3 (2017) Annual MNA Report**

Geosyntec Consultants

Location	Analyte	N	Detection Frequency	Mann-Kendall (S)	Z Statistic	COV	Probability	Confidence in Trend	Concentration Trend	Comment
MW-04	cis-1,2-Dichloroethene	10	100	30	--	0.24	(0.0023, 0.0046)	(0.9954, 0.9977)	Increasing	exact p-value could not be computed
MW-04	Ethene	10	30	--	--	--	--	--	NA	
MW-04	Tetrachloroethene	10	100	15	--	0.31	0.108	0.892	No Trend	
MW-04	Trichloroethene	10	100	19	--	0.15	0.054	0.946	Probably Increasing	
MW-04	Vinyl Chloride	10	0	--	--	--	--	--	NA	
MW-07	cis-1,2-Dichloroethene	10	90	-25	--	0.38	0.014	0.986	Decreasing	
MW-07	Ethene	10	10	--	--	--	--	--	NA	
MW-07	Tetrachloroethene	10	80	-7	--	0.30	0.300	0.700	Stable	
MW-07	Trichloroethene	10	100	-21	--	0.42	0.036	0.964	Decreasing	
MW-07	Vinyl Chloride	10	0	--	--	--	--	--	NA	
MW-09S	cis-1,2-Dichloroethene	10	100	-24	--	0.50	(0.014, 0.023)	(0.977, 0.986)	Decreasing	exact p-value could not be computed
MW-09S	Ethene	10	60	-17	--	1.07	0.078	0.922	Probably Decreasing	
MW-09S	Tetrachloroethene	10	100	-8	--	0.45	(0.242, 0.3)	(0.7, 0.758)	Stable	exact p-value could not be computed
MW-09S	Trichloroethene	10	100	-13	--	0.43	0.146	0.854	Stable	
MW-09S	Vinyl Chloride	10	80	-19	--	0.68	0.054	0.946	Probably Decreasing	
MW-10S	cis-1,2-Dichloroethene	10	100	11	--	0.28	0.190	0.810	No Trend	
MW-10S	Ethene	10	60	10	--	0.98	(0.19, 0.242)	(0.758, 0.81)	No Trend	exact p-value could not be computed
MW-10S	Tetrachloroethene	10	100	0	--	0.58	>0.5	<0.5	Stable	
MW-10S	Trichloroethene	10	100	13	--	0.30	0.146	0.854	No Trend	
MW-10S	Vinyl Chloride	10	0	--	--	--	--	--	NA	
MW-11S	cis-1,2-Dichloroethene	10	100	-25	--	0.46	0.014	0.986	Decreasing	
MW-11S	Ethene	10	40	--	--	--	--	--	NA	
MW-11S	Tetrachloroethene	10	90	-28	--	0.22	(0.0046, 0.0083)	(0.9917, 0.9954)	Decreasing	exact p-value could not be computed
MW-11S	Trichloroethene	10	100	-32	--	0.37	(0.0011, 0.0023)	(0.9977, 0.9989)	Decreasing	exact p-value could not be computed
MW-11S	Vinyl Chloride	10	0	--	--	--	--	--	NA	

**Notes:**

N = Total number of samples. The full post-Cap data set was used in this analysis (i.e., 2015, 2016, and 2017 data).

Mann-Kendall (S) = Mann-Kendall test statistic

Z Statistic = Standardized Mann-Kendall S value based on the normal approximation (for sample sizes greater than 10)

COV - coefficient of variation calculated as the ratio of sample standard deviation to the sample mean

Probability = Probability associated with Mann-Kendall Hypothesis Test (i.e., p -value associated with the S/Z Statistic). For sample sizes N ≤ 10, if an exact p-value was not available, then a range for the p-value was provided as: (minimum p-value, maximum p-value), where the minimum and maximum p-values correspond to |S|-1 and |S|+1, respectively.

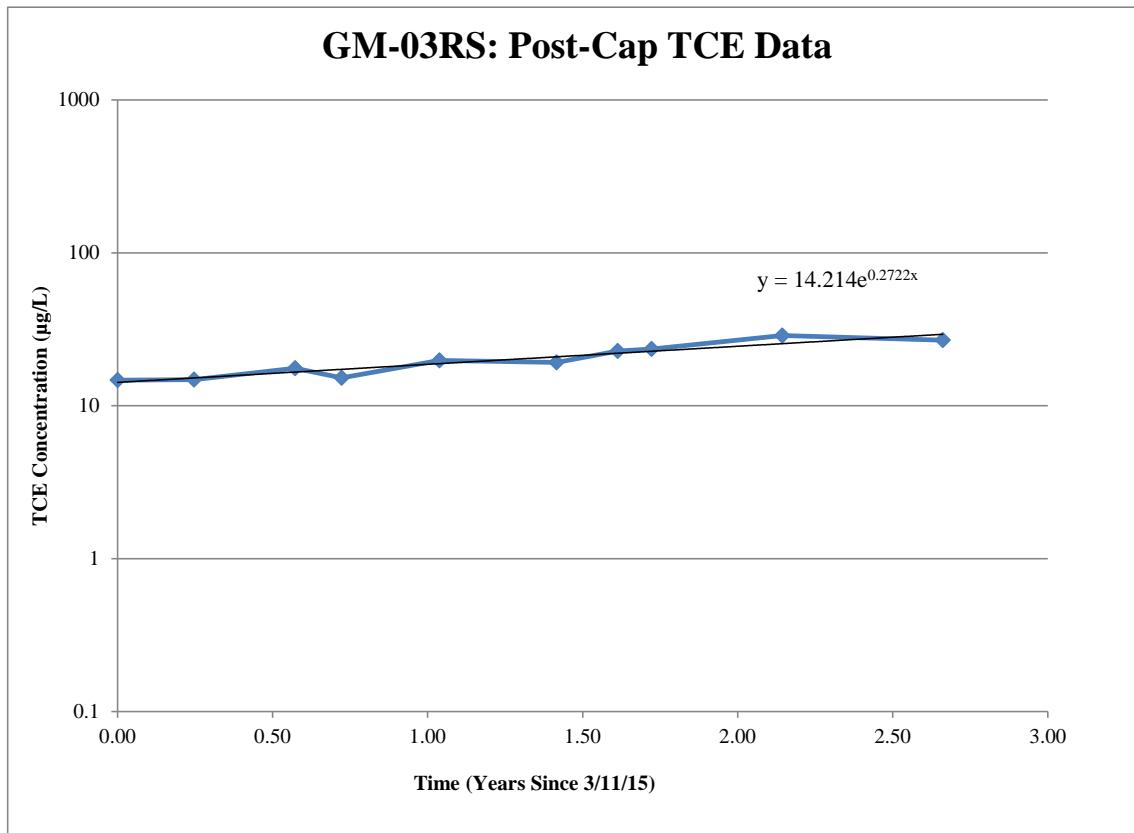
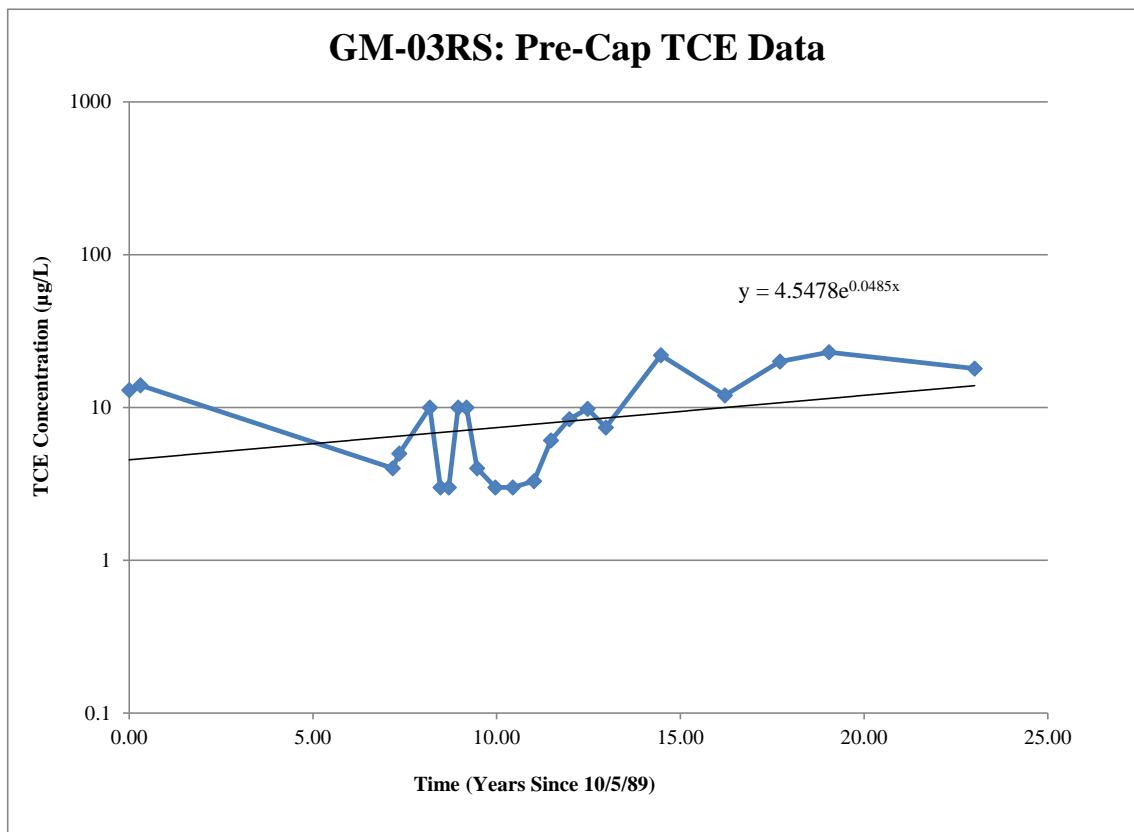
Concentration Trend = Indication of whether Mann-Kendall test can detect a trend, and if so, the direction of the trend is shown

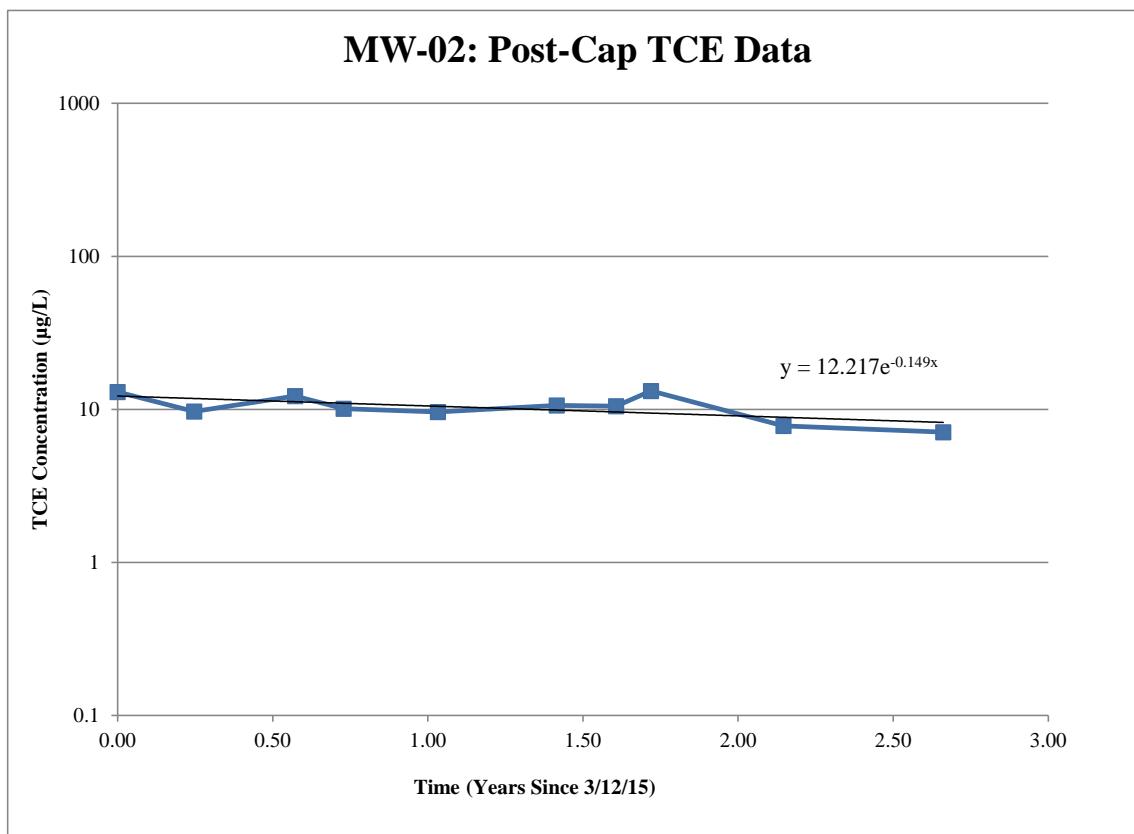
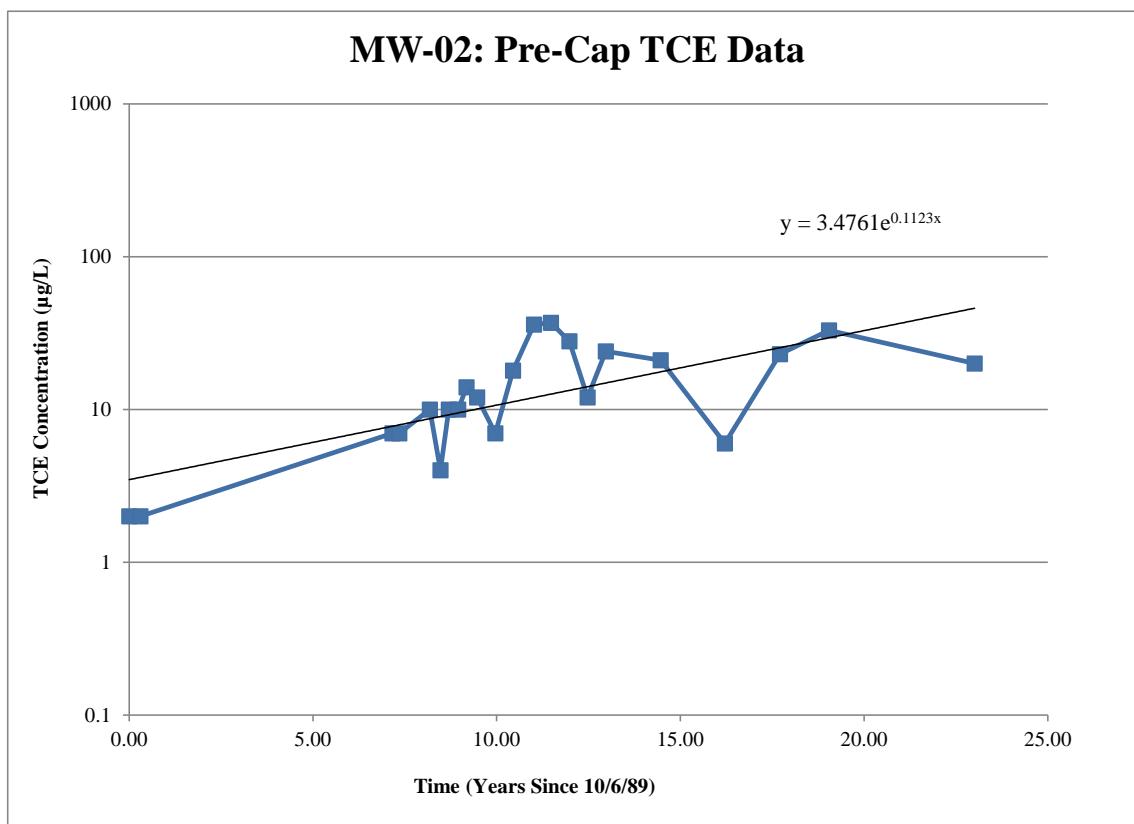
-- = not calculated due to N<4 or <50% detection frequency

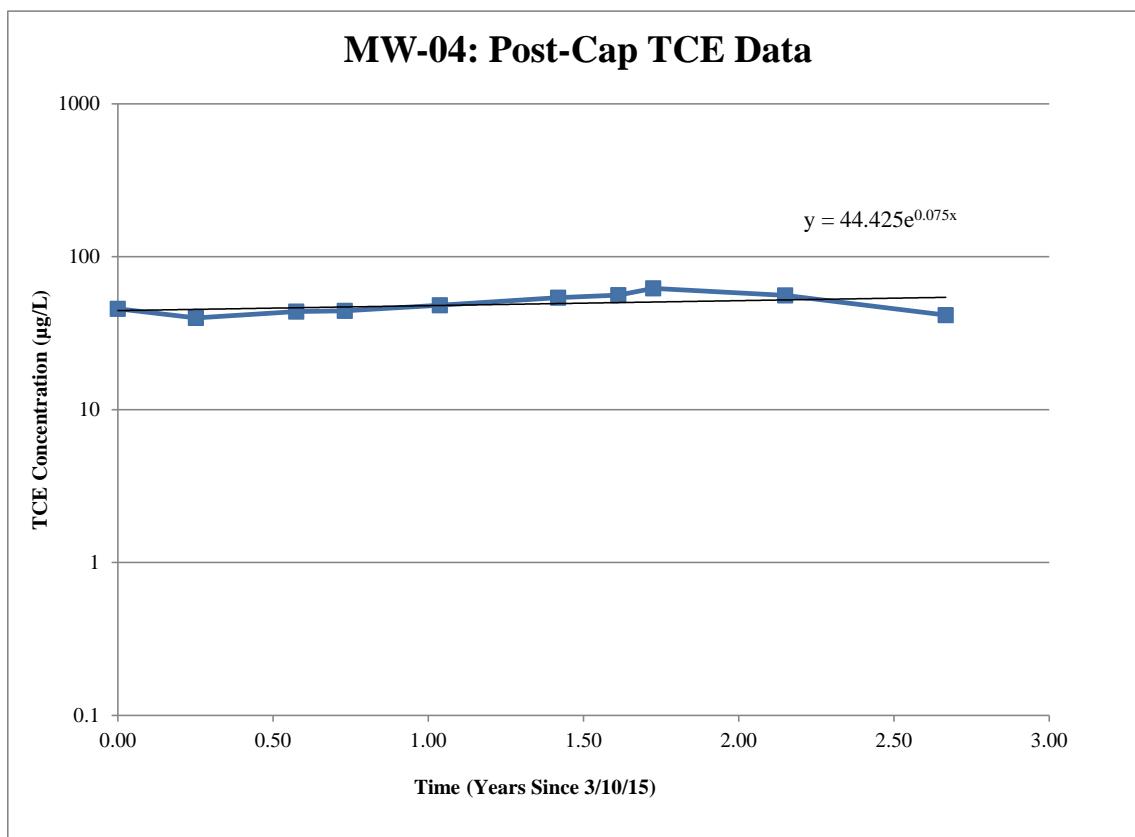
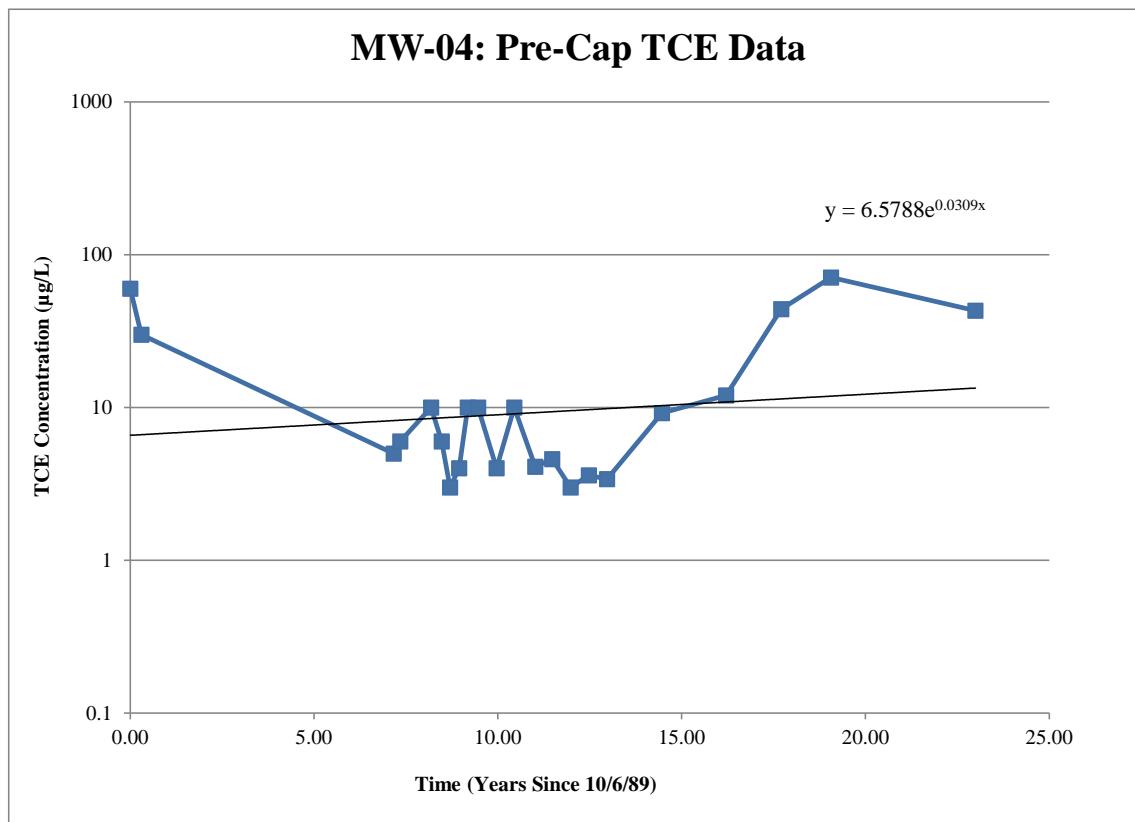
NA = Not analyzed due to N<4 or <50% detection frequency

## **APPENDIX E**

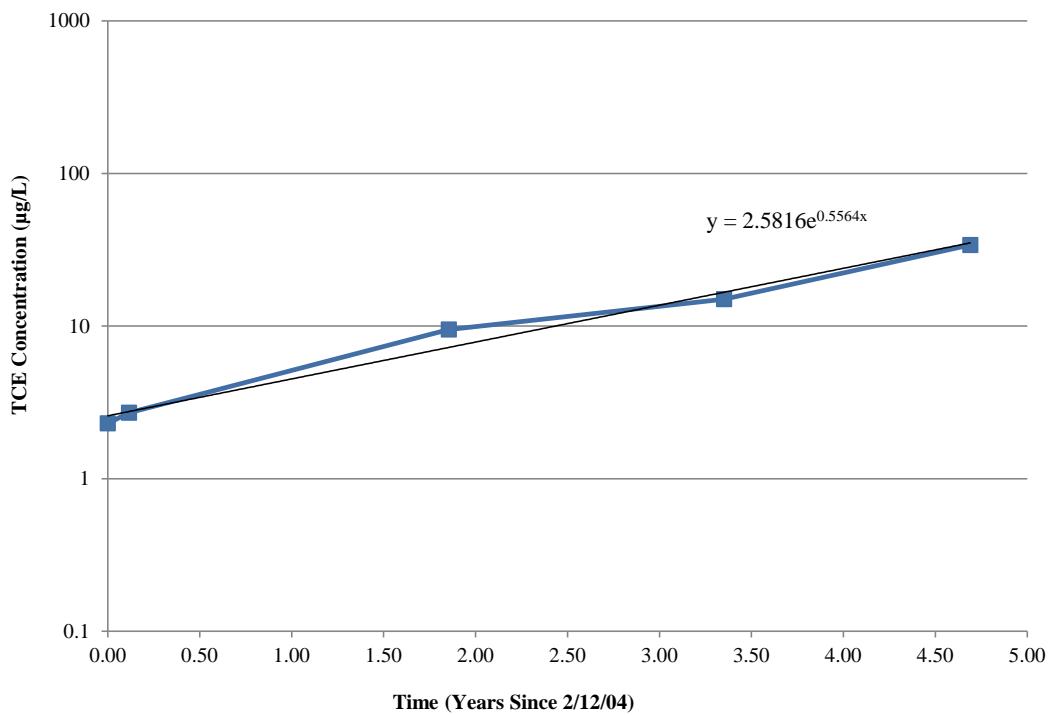
### **First-Order Natural Attenuation Rates Plots**



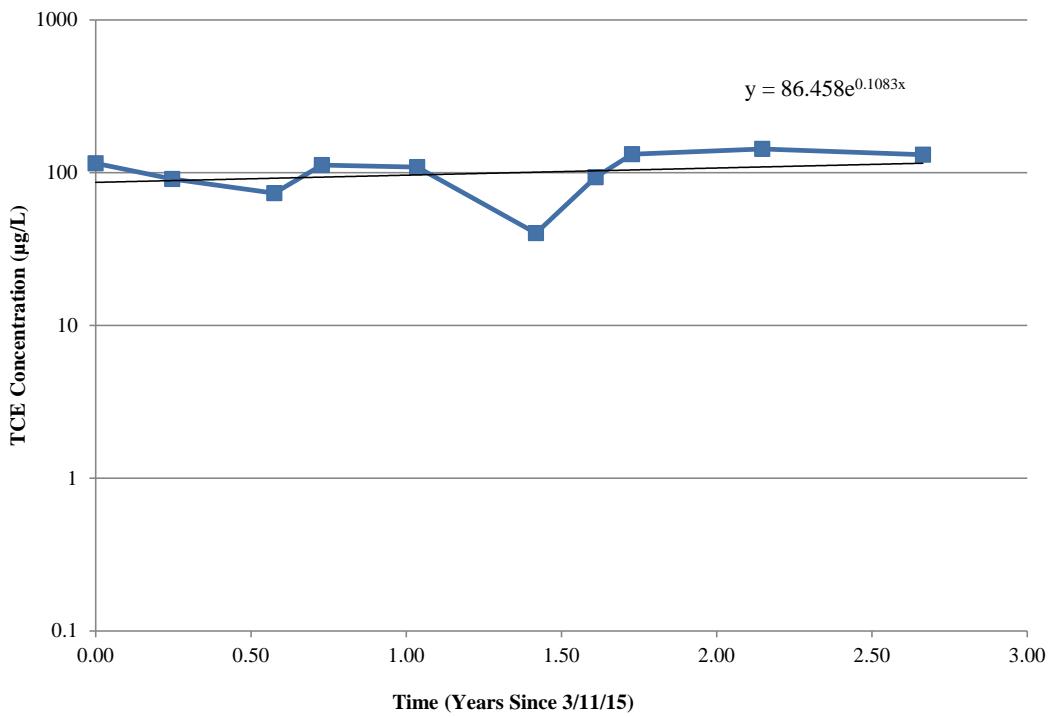


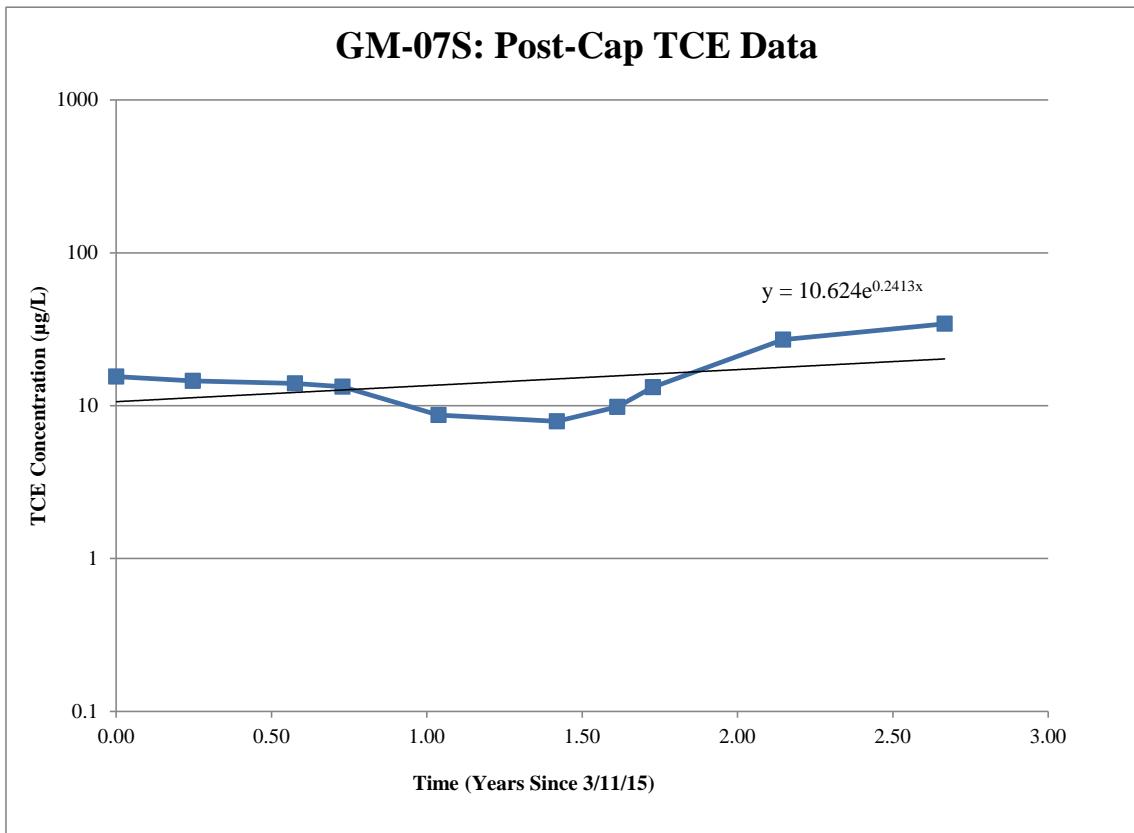
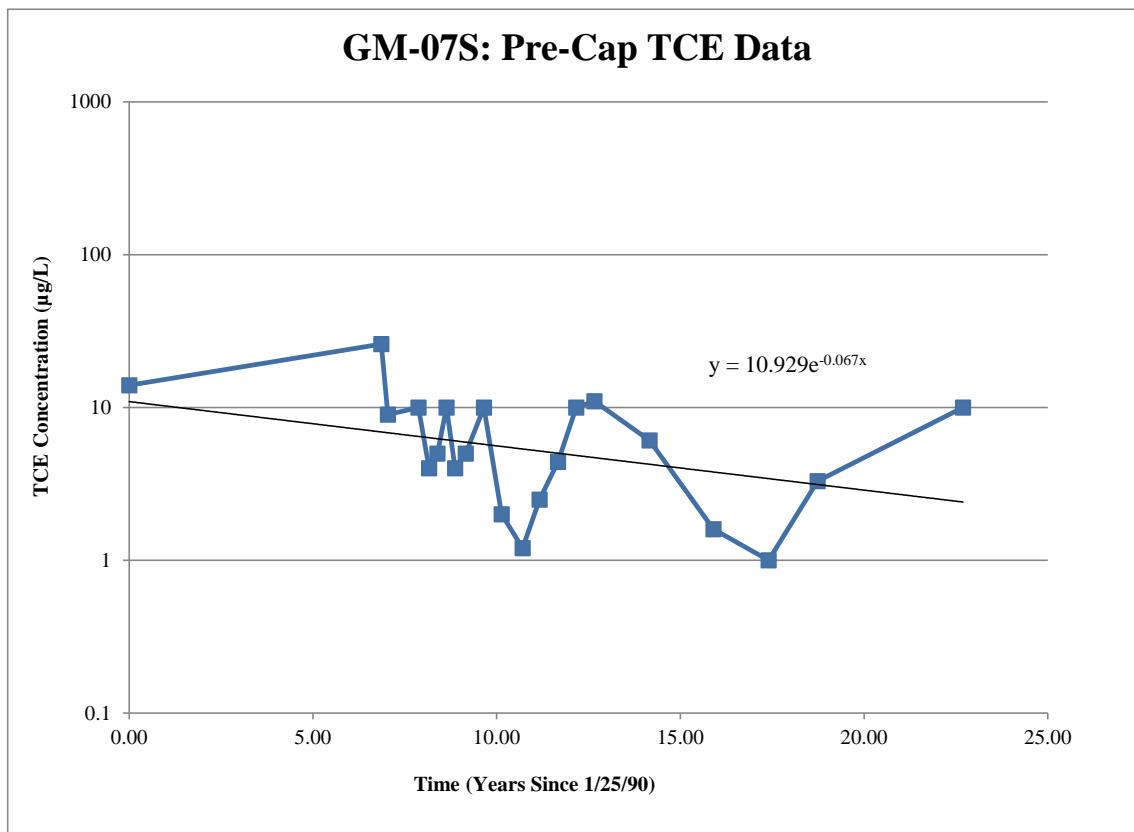


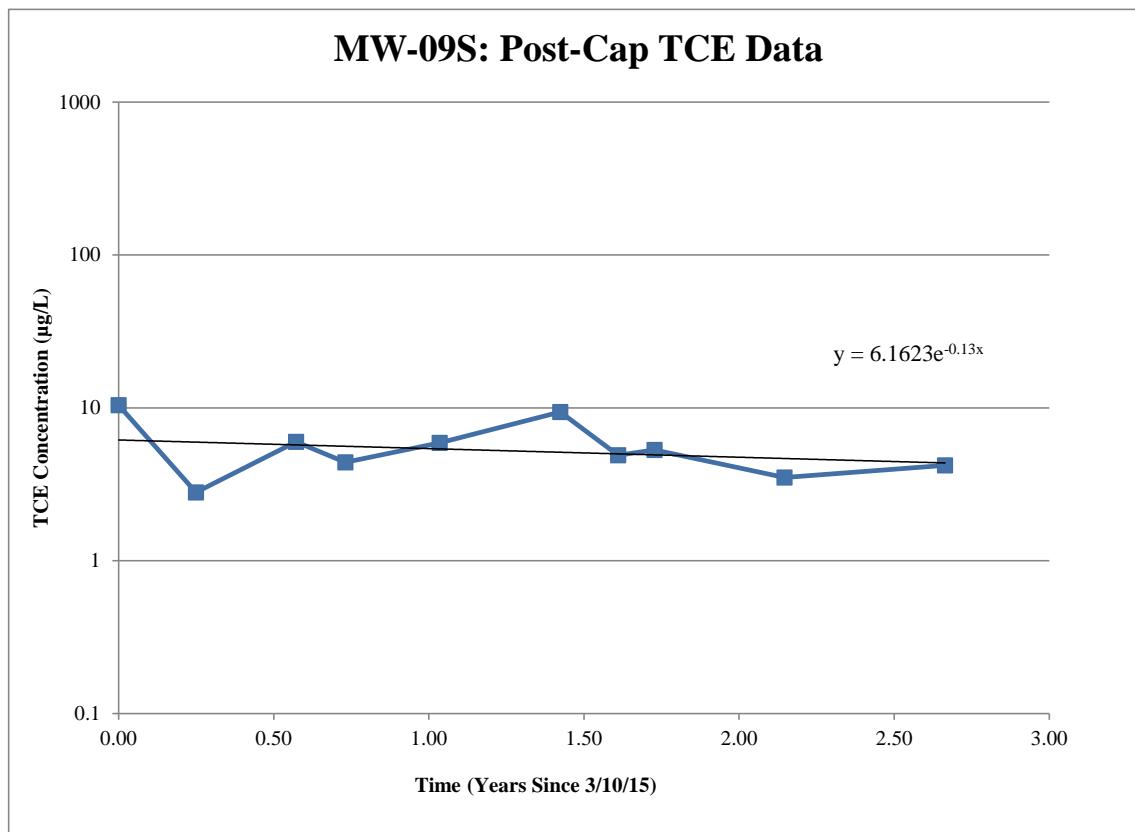
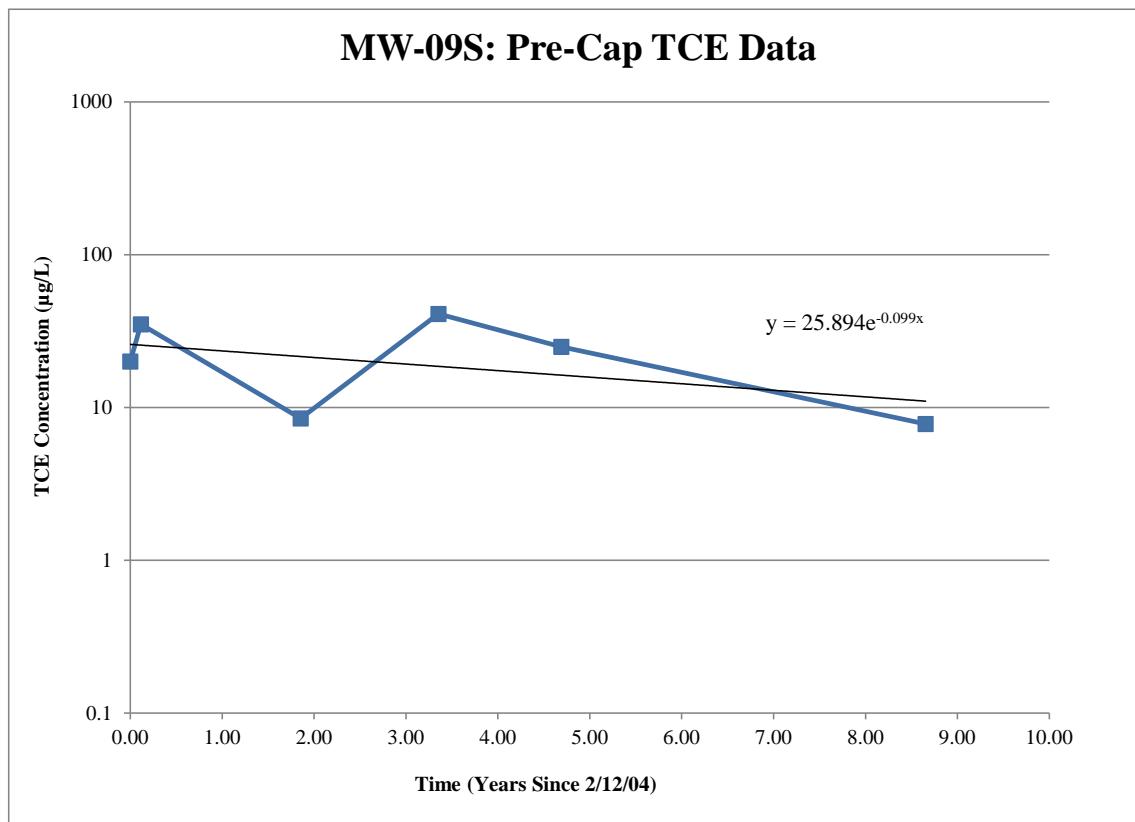
### **MW-10S: Pre-Cap TCE Data**

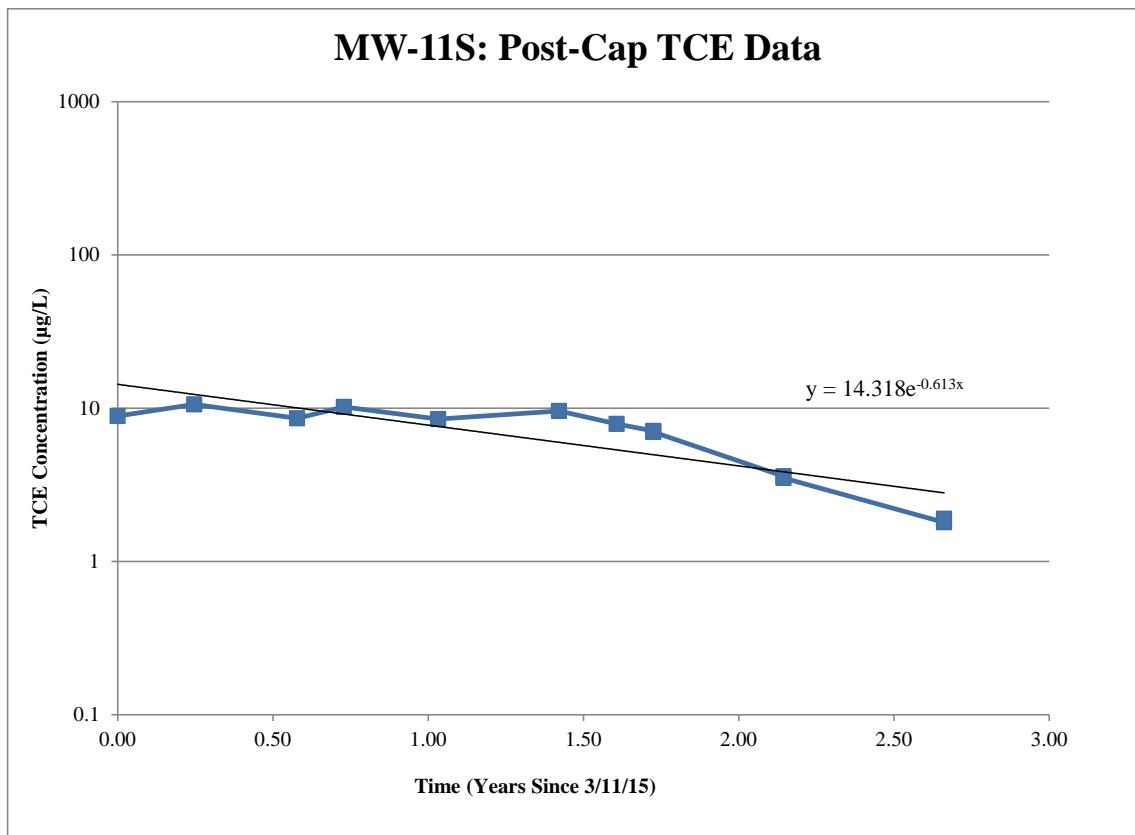
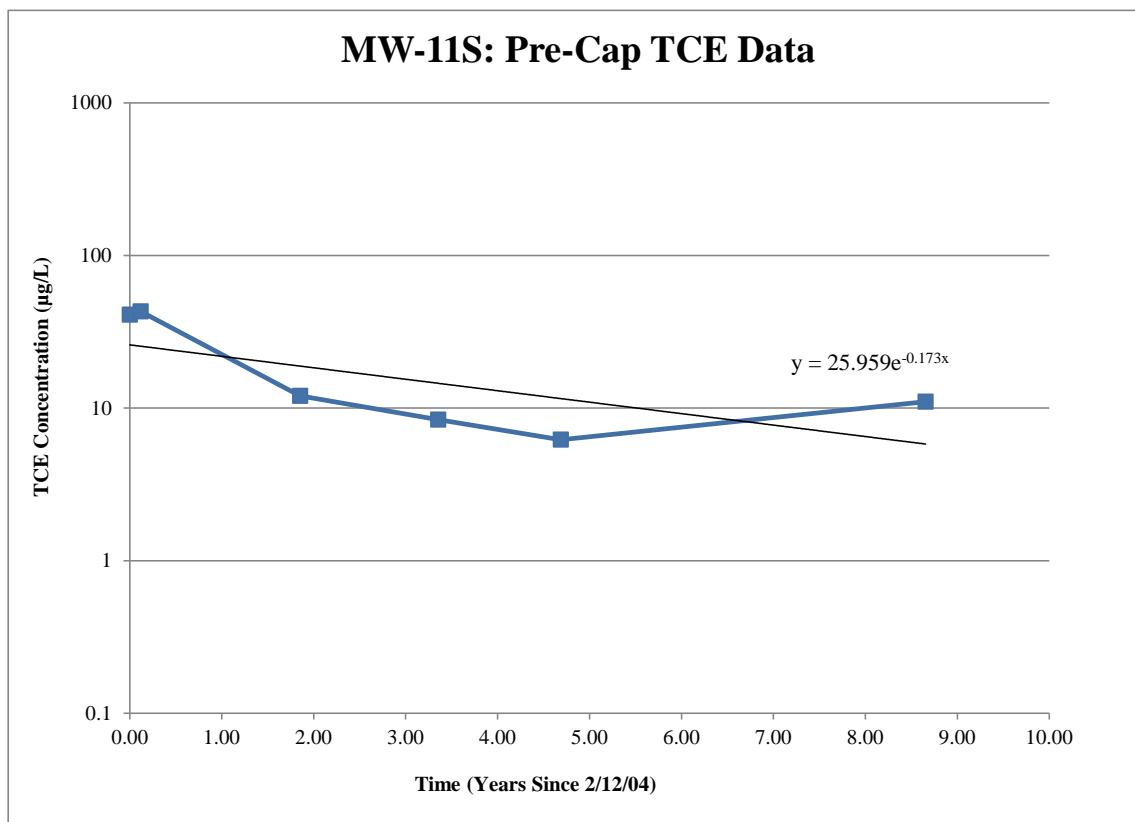


### **MW-10S: Post-Cap TCE Data**

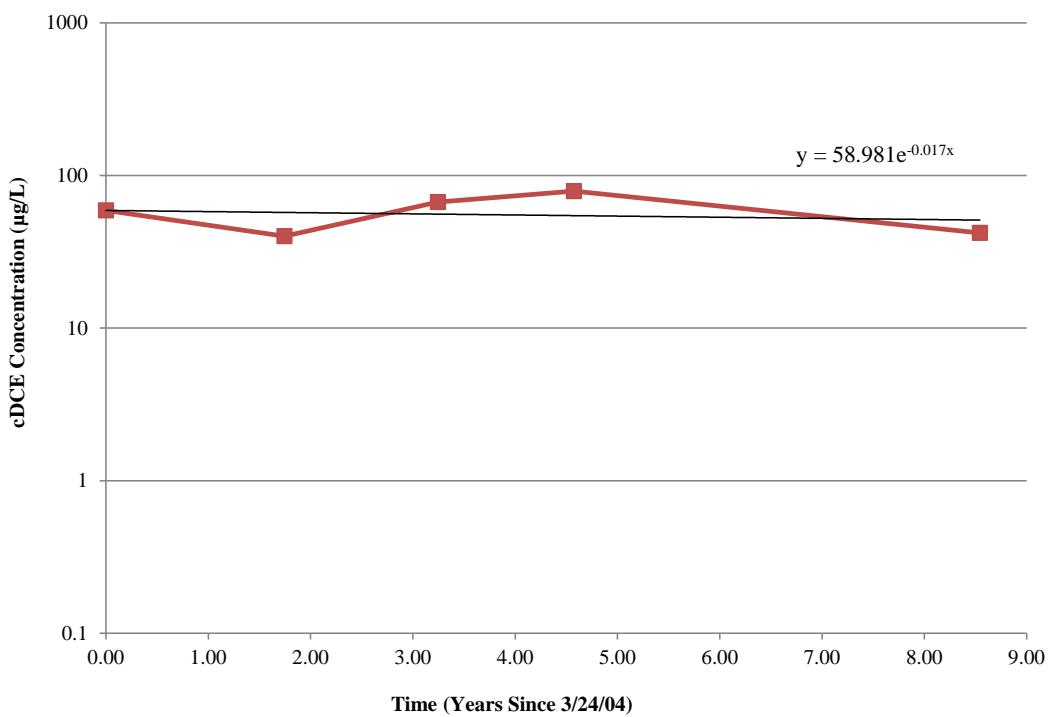








### **GM-03RS: Pre-Cap cDCE Data**



### **GM-03RS: Post-Cap cDCE Data**

